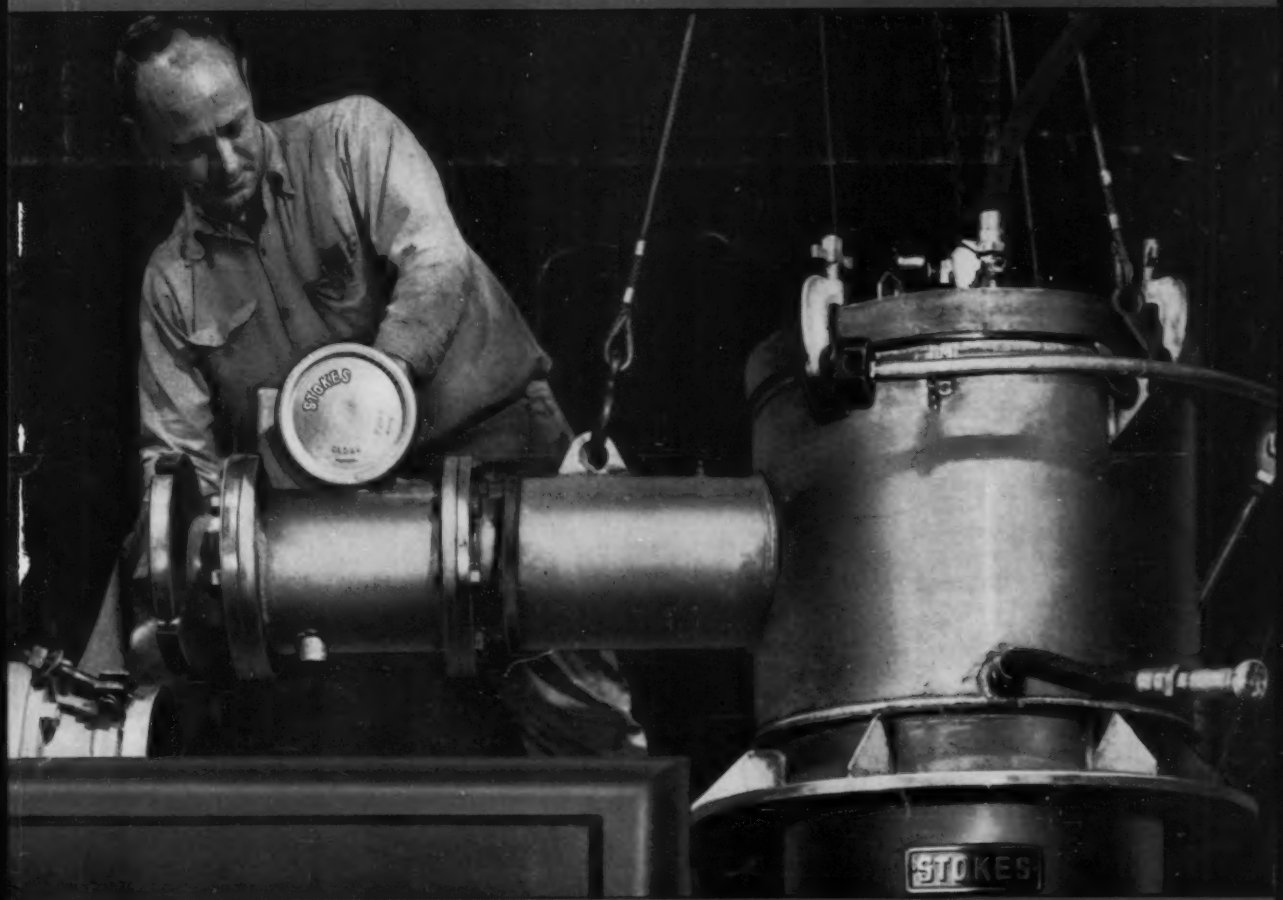
November-December 1956

METAL TREATING

Equipment such as this resistance-heated vacuum furnace with a bell-type retort is used for the annealing and degassing of atmosphere-reactive metals. (See page 2).

Photo courtesy of F. J. Stokes Corporation, Philadelphia, Pa.



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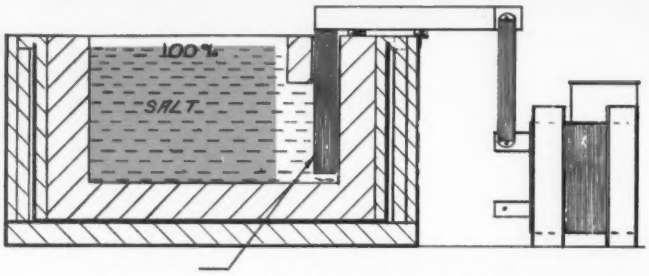

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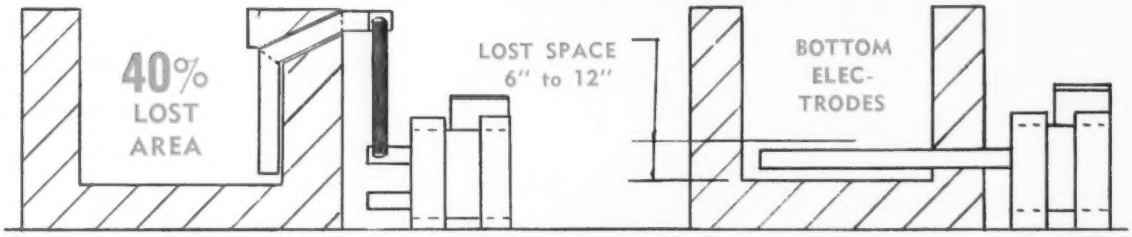

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Vol. VII No. 6
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EDITORIAL

Another Banner Year for the Heat Treating Industry

Now that December, 1956, is here and is rapidly drawing to a close, let us pause a moment and look back over the months that have passed in order to take stock as to just what progress and developments have taken place in the heat treating industry. Then in the spirit of the year's end, let us see what the forecasters are predicting for the heat treating industry during the new year of 1957. (For a more detailed analysis see Mr. Carl L. Ipsen's article "Heat Treating Highlights of '56" on page 10).

Statistics indicate that 1956 was another record year for the progress and development of the heat treating industry both in technical advances and in the growth of heat treating activity. In the furnace industry, the year 1955 broke all previous records for a peacetime year in the amount of new orders, but 1956 indicates a 33% greater volume than last year.

A list of the products manufactured today, whether used in the home or in industry, that depend upon heat treatment for better quality and durability, is an impressive one. As the nation's consumption of every type of product increases, it is only natural that heat treating will become even more and more important and vitally essential to our nation's basic economy.

Important technical advances have also been made by the heat treating industry. Probably the leading trend has been to more continuous automatic heat treating. Completely automatic heat treating lines have been set up where carburizing, quenching, washing, reheating, final quenching and tempering operations are all automatically done. Such progress in modern heat treating equipment has enabled the industry to perform jobs previously thought impossible and has brought about cost, labor, and time savings along with better quality control.

What is the outlook for the industry for 1957? Most predictions are that business will remain at the 1956 level, and one equipment manufacturer predicts that there will be an annual sales volume of more than $200 million by 1965 for the industrial heating industry.

Technically, new and improved equipment and supplies will continue to appear to help the heat treater. More and more automation; more accurate control of atmospheres and the development of new ones; wider use of vacuum furnaces for heat treating and annealing; and the use of higher temperatures for brazing of alloys—just to mention a few. Heat treating is coming into its own as a well developed major science creating and establishing many benefits for mankind.

To all—season's greetings and our wishes for a very prosperous and happy 1957!

C. E. Herington

CONTENTS

THE SUCCESSFUL USE OF VACUUM HEAT TREATING METHODS WITH ATMOSPHERE-REACTIVE METALS

By **Harry L. Hovis,**
Superintendent of Metals Processing
Hamilton Watch Company
Lancaster, Pa.

VACUUM heat treating is now being rapidly accepted throughout industry as the most satisfactory method of treating certain metals, especially those alloys which have age hardening properties. In particular, the growing demand for atmosphere-reactive metals like titanium and zirconium is requiring the installation of many vacuum furnaces for age hardening, annealing, and degassing. In fact, it can be said that the advances made in these metals for both essential defense and industrial applications have been made possible mainly through the development of vacuum heat treating equipment.

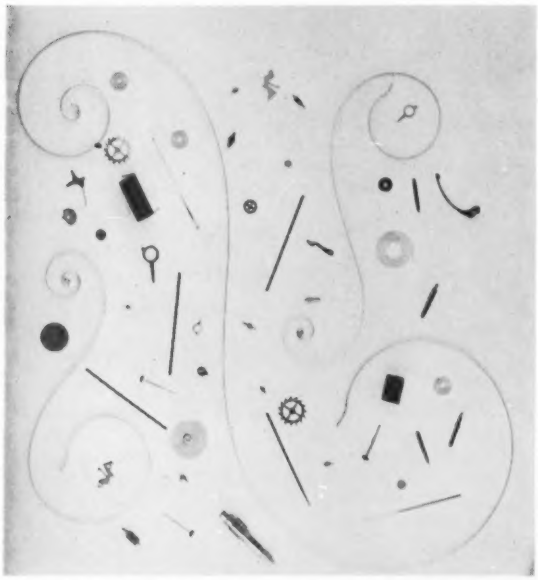

Fig. 1—Typical small parts and springs made of atmosphere-reactive metals that are vacuum heat treated at Hamilton Watch Company.

The use of vacuum for heat treating metals on an industrial basis is relatively new. Hamilton Watch Company entered this field in 1940 for the treatment of its newly developed "Elinvar Extra" which was used for the manufacture of hairsprings. This alloy required age hardening in order to obtain the maximum physical properties and satisfactory functions. However, conventional atmosphere furnaces produced discoloration even though purity of gases was controlled and a very low dew point was maintained. Since hairsprings run as small as .0007" by .003" (one-fifth the thickness of a human hair) and are mirror-finished to an accuracy of 1/200,000ths of an inch, any oxidation would clearly affect their functioning. (See Fig. 1)

At that time very few vacuum furnaces were commercially available and it was, therefore, necessary to actually build our own units for this miniature application. (See Fig. 2). Significantly, parts came out even brighter than when they entered the unit. This was due to removal of gases from the furnace which tended to discolor or oxidize the metal. These custom-built furnaces were in constant use and produced satisfactory results until 1949 when a commercial unit was purchased from National Research Corporation, Newton Highlands, Mass.

The development by Hamilton of a high temperature, high strength alloy, "Dynavar", for mainsprings

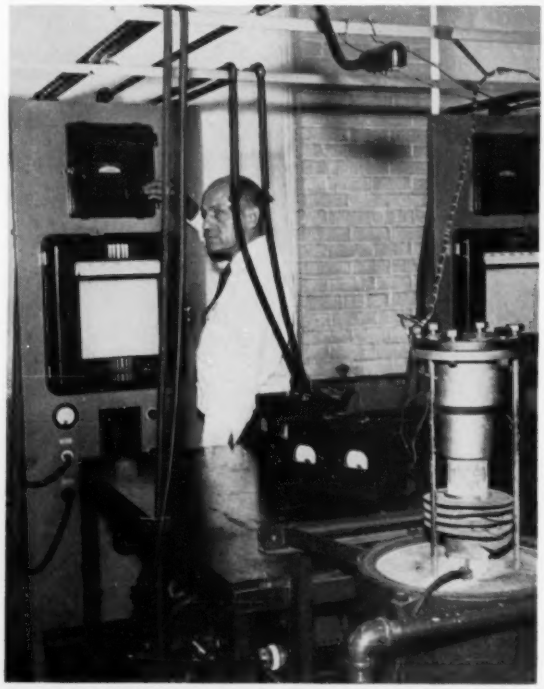

Fig. 2—Author Harry L. Hovis checks controls on Hamilton's oldest vacuum furnace, one of five such units custom-built in 1940 to treat hairsprings made of "Elinvar Extra." New equipment has already replaced four of these furnaces.

also required the use of vacuum for successful age hardening. The above larger unit purchased in 1949 was used for this alloy. The furnace was operated with an average cycle of 8 to 10 hours (4 hours heating at 1200°F, and 4-6 hours of air cooling under vacuum). (See Fig. 3).

The application of these two alloys, "Elinvar Extra" and "Dynavar" to commercial uses other than watch springs soon resulted in a demand for the use of Hamilton facilities for vacuum heat treating of springs, diaphragms and other parts manufactured from these and other age hardening materials. Due to this demand, another custom-made vacuum furnace was purchased from F. J. Stokes Corporation, Philadelphia, Pa. during 1954. These furnaces have replaced most of the original Hamilton-made units and assure proper treatment with a surface condition free of discoloration. (See Fig. 4).

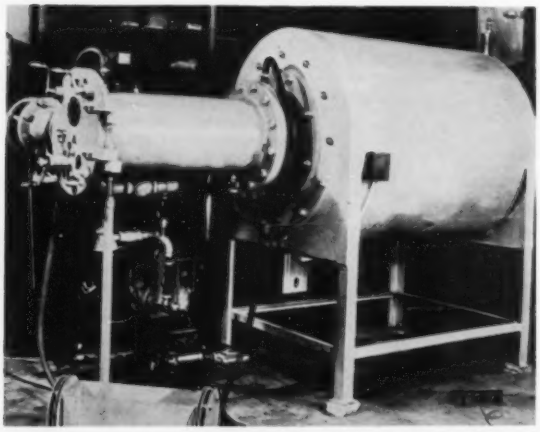

Fig. 3—Pioneer vacuum heat treating furnace built in 1949 by National Research Corp. for Hamilton Watch Co. for age hardening of alloys.

The adoption of 420-F stainless steel for certain watch parts created the need for additional vacuum facilities for annealing in order to attain the desired quality of strength and toughness. Vacuum annealing had previously been found superior to conventional atmosphere annealing procedures for similar high-chromium alloys. A large retort type vacuum annealing unit was, therefore, purchased during 1954 for this application. (See Fig. 5). The size of the retort for this unit is 19" ID x 43" long. This unit can be operated to a maximum temperature of 2000°F. The demand by outside firms for use of this equipment for other commercial applications has increased very rapidly during the past year with the result that it is in operation practically full time. As mentioned previously, atmosphere-reactive metals such as titanium and zirconium also require vacuum heat treating for annealing and degassing. The procurement of this unit along with rolling mill facilities has permitted Hamilton the opportunity of processing these alloys in such a way that surfaces are actually brighter after being annealed than they were before entering the furnace.

Annealing is not the only reason for vacuum heat treating of titanium. This metal must be gas-free if it is to be cold worked successfully, and heating followed by cooling under vacuum is the only way to draw out hydrogen, oxygen, nitrogen and other gases found in titanium.

Demand for vacuum heat treating of titanium is increasing rapidly as industry finds new uses for it. Titanium's high strength-to-weight ratios at temperatures up to 850°F and its excellent corrosion resistance makes it invaluable for military and commercial plane parts—particularly for jets, and for chemical tank liners. Currently, titanium is being used in food processing equipment since it is not affected by long contact with such acidic products as tea and tomato juice; nor does titanium affect the flavor or color of foods.

A recent Hamilton accomplishment was the annealing, degassing and rolling of perfectly flat titanium foil to a thickness of only .0022", yet strong enough to be used as shutters for high-speed aerial cameras that are being made by the Fairchild Camera and Instrument Corporation for the U.S. Air Force. This alloy has been rolled as thin as .0003".

Zirconium is another wonder metal that is being vacuum heat treated by Hamilton in ever-greater quantities. Strong as steel but lighter, zirconium has unusual corrosion resistance even to nitric acid, hot phosphoric acid and other problem-makers in chemical processing. These properties made it ideal for chemical system valve parts and filter screens, as well as for electronic tube grids and shields and special instrument parts.

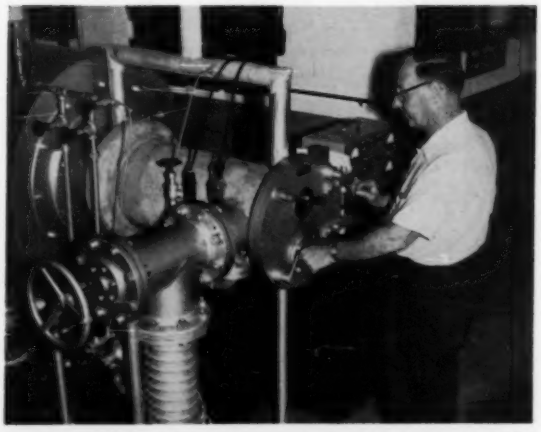

Fig. 4—This vacuum furnace was made to order for the Hamilton Watch Company in 1954 by F. J. Stokes Corporation. In addition to the treatment of certain watch parts, it is being used for many other commercial applications.

Also of great importance is the fact that zirconium does not absorb neutrons, a quality that lends it to use as a liner for atomic energy reactors of the thermal neutron type.

Fig. 5—This large retort-type vacuum annealing unit can be operated to a maximum temperature of 2000°F. It is used to treat high-chromium alloys such as 420-F stainless steel, and atmosphere-reactive metals like titanium and zirconium.

Without vacuum heat treating, however, zirconium would be an extremely limited metal, since it cannot be cold-worked successfully unless it is thoroughly degassed. As zirconium normally has a strong affinity for oxygen and nitrogen at high temperatures, it would pick up even more of these gases under usual heat treating conditions.

It has also been found that vacuum treating has merits for annealing and transforming of the newly developed age-hardened stainless steel 17-7 PH. And increasingly greater quantities of this alloy are being transformed by Hamilton for outside customers.

In all cases it is imperative that vacuum be maintained not only prior to and during the heating cycle but also during the cooling process following treatment. Where very clean surfaces are required, the active metals are placed in a container made of titanium so that any gases remaining in the retort are absorbed by the container rather than the metal itself.

The use of vacuum heat treating is not applicable when it is necessary to actually quench alloys in order to obtain maximum physical properties. Therefore, while vacuum treatment has replaced atmosphere furnaces for many applications, Hamilton still uses conventional atmosphere furnaces for treatment of regular alloys. There is little question that the use of vacuum will increase very rapidly as the demands for titanium and zirconium increase and their costs become competitive with commercial alloys.

No discussion is presented in this article relative to vacuum as applied to melting, but its use for this application is being rapidly adopted through the metals processing industries. ■■■

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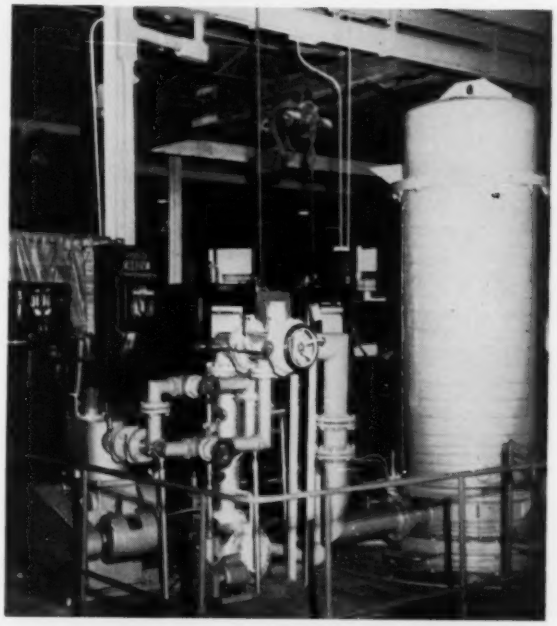
If you ought to adapt one of your present furnaces, NRC can supply everything needed to convert it for vacuum operation. This is a reversible conversion, so that you can easily return the furnace to its former service. If you prefer, we can provide a pumping system to mate with a muffle furnished by you, as we did for the installation shown in the top picture.

Should your needs best be met by a new furnace, NRC offers a wide line of standard models. These include horizontal furnaces with diameters from 2″ to 14″, bell type furnaces with uniform hot zones having diameters and heights ranging from 12″ by 12″ to 54″ by 48″, and pit furnaces with hot zones varying from 12″ by 12″ to 54″ by 12′. We can modify these standard units or design special furnaces which will exactly meet your particular requirements.

To get detailed information, or to have a sales engineer call, write today to NRC Equipment Corporation, Department 2912, Charlemont Street, Newton 61, Massachusetts.



This two zone pit furnace was converted for vacuum operation. NRC supplied the pumping system to mate with the customer's muffle.

Operator lowers resistance heated bell furnace over vacuum muffle in NRC Model 2936 Vacuum Heat Treating Furnace. Work inside the muffle can be heated to 2000°F at pressures below a millionth of an atmosphere.

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There just never has been a heat treating furnace like this new Lindberg Induct-O-Ring. Radically different, it has no elements, element terminals, burners, electric or gas connections in the furnace proper. The chamber, lined with a heat-resistant alloy muffle and deeply insulated, is heated by induction. All the heat is in the chamber and the work load.

Heating efficiency is high and the heating rate spectacular, with hardening temperatures reached in 17 minutes from cold. Temperature control is highly accurate and precise and temperature override and lag is eliminated for all practical purposes.

With no burners or heating elements maintenance costs and down-time are materially reduced and atmosphere requirements held at a minimum.

The Induct-O-Ring's circular shape eliminates door-opening heat and atmosphere losses and saves floor space. Actually, it is possible to have 30 feet of furnace length in a 5 foot diameter unit.

Operation of the furnace is extremely simple. Work load is automatically charged and moved through the work chamber by a gentle reciprocating movement of the entire furnace. Work is then automatically discharged into quench tank.

The Induct-O-Ring is built like a fine machine tool. Sealed ball bearings support the moving parts of the furnace. Quench tank, quench conveyor, circulation and cooling of the quench are all self-contained.

The furnace is completely adaptable to automated production processes where its precise heat control, negligible maintenance, and dependable operation are of particular importance.

We are sure that the Induct-O-Ring offers an entirely new concept in heat treating efficiency and economy. You can very easily find out how it can be used in your production processes. Just call your nearest Lindberg Field Representative (consult your classified phone book).

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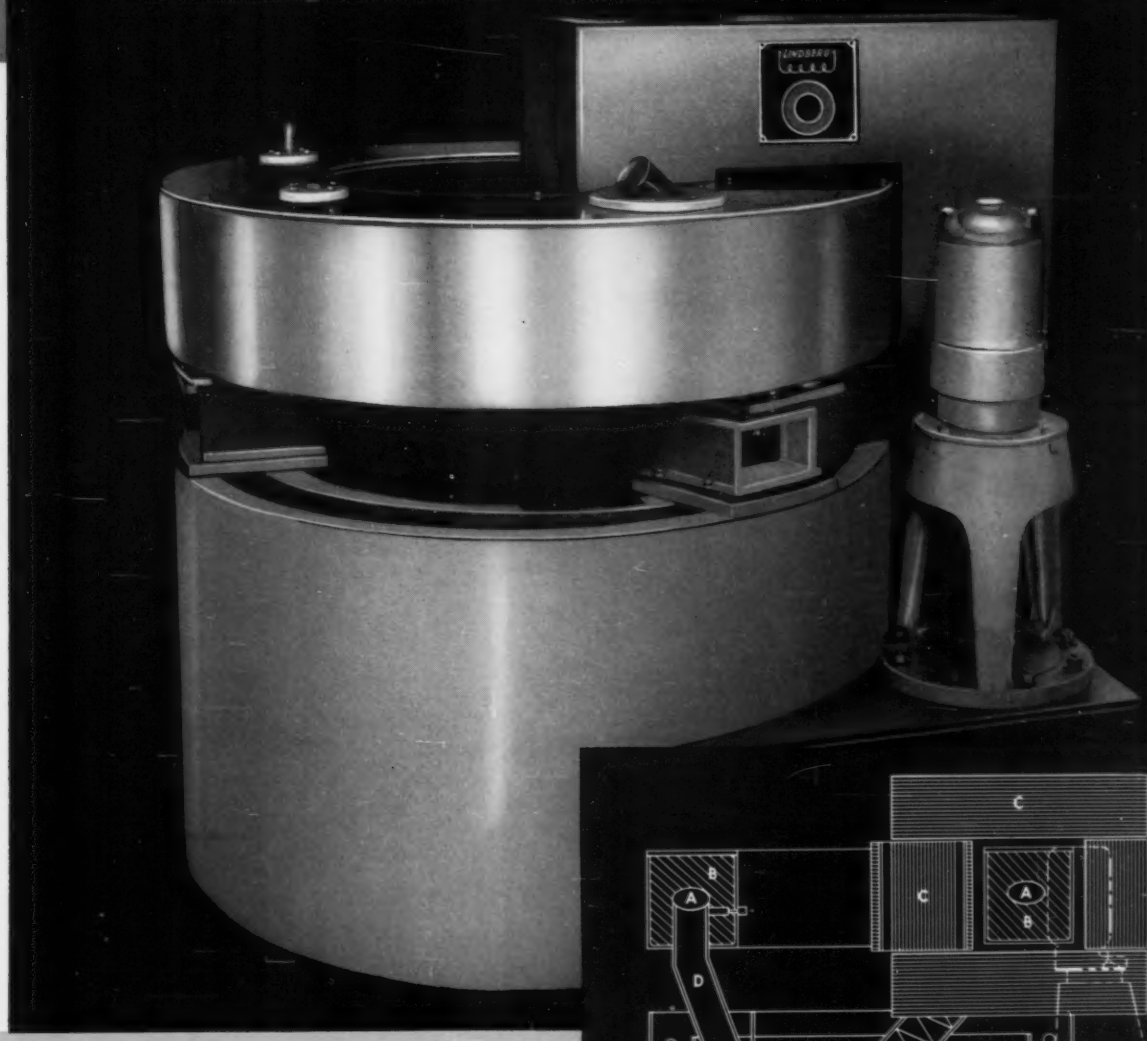

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IMPROVEMENT IN SALT BATH POT LIFE PROVED BY FIELD DATA

By **Roger P. Welles,** *President*
Rolock, Inc.
Fairfield, Conn.

WHEN the fabricated Inconel* salt pot was first introduced about a year and a half ago, it was received with considerable interest but with some reservations. Some heat treaters felt that this was the answer to their biggest problem with neutral salt bath furnaces, which was unpredictable and often extremely short pot life. However, most of them wanted more substantiated information on service life before making an installation.

Load of small parts being removed from neutral salts bath furnace at Eastern Heat Treating & Brazing Company. Before using a fabricated Inconel pot, the company was troubled with extremely short pot life plus unpredictable failures. Their Inconel pot has now been in operation more than 4,000 hours.

Fabrication of salt pot in Rolock's plant begins with shearing plate to proper dimensions and beveling edges to the proper angle to get optimum weld penetration.

Now, enough data has been gathered to show that the new pots definitely offer improved performance. A survey of some 27 installations, summarized in Table I, indicates that the Inconel nickel-chromium alloy pots last from two to thirty times as long as types previously used. The variation in results is attributed to differences in operating conditions as well as differences in construction of pots that were replaced.

Except for pot life, neutral salt bath furnaces are compact, efficient and reliable. Parts are quickly and uniformly hardened by immersing them in the molten salt solutions for a specified time and quenching quickly.

However, the unpredictable pot failures resulted in high operating costs and made it virtually impossible to set realistic production schedules.

Some previous designs of salt pots were satisfactory when new, but soon developed a heavy scale on the outside surface which reduced heat flow and cut pro-

(Continued on page 26)

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TABLE I
SUMMARY OF USERS' REPORTS ON INCONEL SALT POTS

Type of Service	Pot Size, in.	Operating Temp. deg. F	Life of Inconel Pot	Life of Previous Pot	Fuel	Remarks
General duty (Fastener manufacturer)	12x18	1200, 1500	165 hrs. @ 1500 F. 2427 hrs. @ 1200 F.	See remarks	Kerosene	No rectifier; pot kept at full fire from start.
General duty	16x27	1300	Still in good condition after 3 mos. (1000 Hrs.)	4 mos.	Gas	Furnace operates about 80 hrs./wk. Not idled.
General duty (Heat treater)	18x24	1300-1575	Still in service after 4 mos. (500 hours)	4-6 weeks		
	24x30	1300-1575	Still in service after 3 mos. (200 hours)	4-6 weeks	Gas	Pot used about 50 hrs. per wk. Not idled.
General duty (Heat treater)	20x20	1350-1400	Still in service after 4000 hrs. operation			
General duty	16x18	1400-1500	1800 hrs. to date; in service	2000 hr. maximum	Gas	Pot idled at 400°F
Intermittent	10x12	1450	Still in service after 6 mos. Used about 3½ days per wk.	6 weeks	Gas	Pot cools nights and weekends
General duty	24x24	1450-1540	Still in good condition after 6 mos. service	450-500 hrs.	Gas	Furnace operates about 60 hrs. per wk. Idled 60 hrs. per wk. at 1400-1500°F.
Severe duty (Tool Mfg.)	14x16	1475	Failed after 1000 hours.	1 week	Gas	Pot used about 50 hrs. per wk. Not idled.
	14x16	1475	Still in service after 560 hours		Gas	Replacement for above.
General duty	20x20	1500-1550	More than 2000 hours	11-13 wks.	Gas	Pot used about 65 hrs. per wk. Not idled.
	20x20	1500-1550	Still in service, after about 450 hrs.		Gas	Replacement for above; 3 now in service.
General duty (Machine tool Mfg.)	16x27	1500-1550	Still in good condition after 6 mos. (1000 Hrs.)	4 mos.		
General duty (Heat treater)	14x18	1500-1600	Still in service; more than 2000 hrs. to date	3-4 weeks		
General duty	14x20	1500-1750	Still in good condition after 5 mos. service	6-9 mos.	Gas	Furnace operates about 80 hrs. wk. Idled at 1350°F about 40 hr./wk.
General duty	18x18	1520	Still in good condition after 14 mos. service		Gas	Furnace operates about 120 hrs. wk.; off weekends. Not idled.
General duty (Fastener) manufacturer)	18x18	1525, 1600	Still in service 300 hrs. to date	6-9 mos. at about 35 hrs. per week.	Gas	Pots not idled. User was so pleased with initial pot that he ordered second one.
General duty (Tool Mfg.)	16x27	1550	Still in good condition after 6 mos. service	8-10 wks.	Gas	Pot used 20 hrs. per wk. idled 100 hrs. at 1250°F.
General duty (Heat treater)	20x24	1550	Failed after 7 mos. (approx. 3350 hrs.)	800-2600 hrs.		
	20x24	1550	Replaced above, in service 2 mos.		Gas	Furnace operates about 32 hr./wk idled at 1300 about 5 hrs/wk.
General duty (Heat treater)	20x30	1550	More than 1500 hrs. to date; still in service	3-4 mos.	Gas	Pot used 16 hrs. per day, 6 days per wk. Expect another 3-4 mos. from Inconel pot.
General duty	10x10	1600	Still in good condition after 10 mos. service	2 mos.	Gas	Pots used about 20 hrs. per wk. Not idled.
	10x10	1600	Still in good condition after 6 mos. service	2 mos.	Gas	Used 6 days/wk. 9 hrs/day. Furnace shut off on weekends.
General duty (Tool and die company)	10x14	1600	Still in service 3960 hrs. operation	3-4 mos.	Electric	Furnace shut off nights.
Severe duty (Heat treater)	18x22	1600-1950	Still in good condition after 2 mos. service	1-12 wks.	Gas	Furnace runs continuously for one to two weeks. Not idled.
General duty (High speed salts)	12x16	1900	Still in service after about 22 heats	1-2 heats	Gas	Outlasted previous pots.

HEAT TREATING HIGHLIGHTS OF '56

By **CARL L. IPSEN**
Executive Vice President
Industrial Heating Equipment Association

THE year 1956 was a banner one for the heat treating industry, both in sales and technical advances. The final results aren't all in yet, but the industry's new orders will top its previous record peacetime year, 1955, by a big margin—to date it is up 33%.

A recent forecast by the members of our Association predicts that business in 1957 will be at approximately the 1956 level.

The year's end is a traditional time to "take inventory", to appraise what progress has been made, and where an individual or an industry is going. It might be instructive to take a quick look at the heat treating highlights of 1956. Progress has gone on at a rapid pace in some areas and this might be a chance to "catch up" for those who haven't had a chance to keep a finger on developments in the many fields of heat treating.

The Industrial Heating Equipment Association took a survey among its membership to see what outstanding new trends, developments and installations might be of interest to *Metal Treating* readers. Here are some of the highlights of their replies:

Trends

1. Automation—true automation, not just adding hoppers, feeders and the like, but doing several operations on a single machine and transferring parts between operations—that seems to be the leading trend in heat treating.

2. Higher operating temperatures—in the range of 2200° to 2600° for applications like the brazing of alloy steels. Production type furnaces are being installed for these new applications, suitable for operation with either protective atmospheres or vacuum.

3. New protective atmospheres of high purity and lower dewpoints. Improved instruments for the automatic control of carbon potential.

4. Increasing use of vacuum equipment for heat treating and brazing.

5. Scale free heating for forging, forming and extrusion.

6. Vacuum melting equipment, not only for special metals and alloys but for the commoner steel alloys, has attracted tremendous interest.

7. Better quality control—using modern equipment, work can be processed under conditions where every step of the operation is handled by predetermined methods and under a schedule of production which insures uniformity of such a nature that inspection and attendance are materially reduced, and the overall product is more quickly available for application to fully-automated progress in plants which have these.

Important New Technical Developments

Great technical advances are being made in heat treating. Modern equipment is doing jobs undreamed of even a few years ago. The opportunities for quality improvement, cost-savings, labor-savings, and time-savings afforded by this modern equipment are rendering obsolete much of the industrial heating equipment in use today.

Here are a few of the outstanding examples of this technical progress:

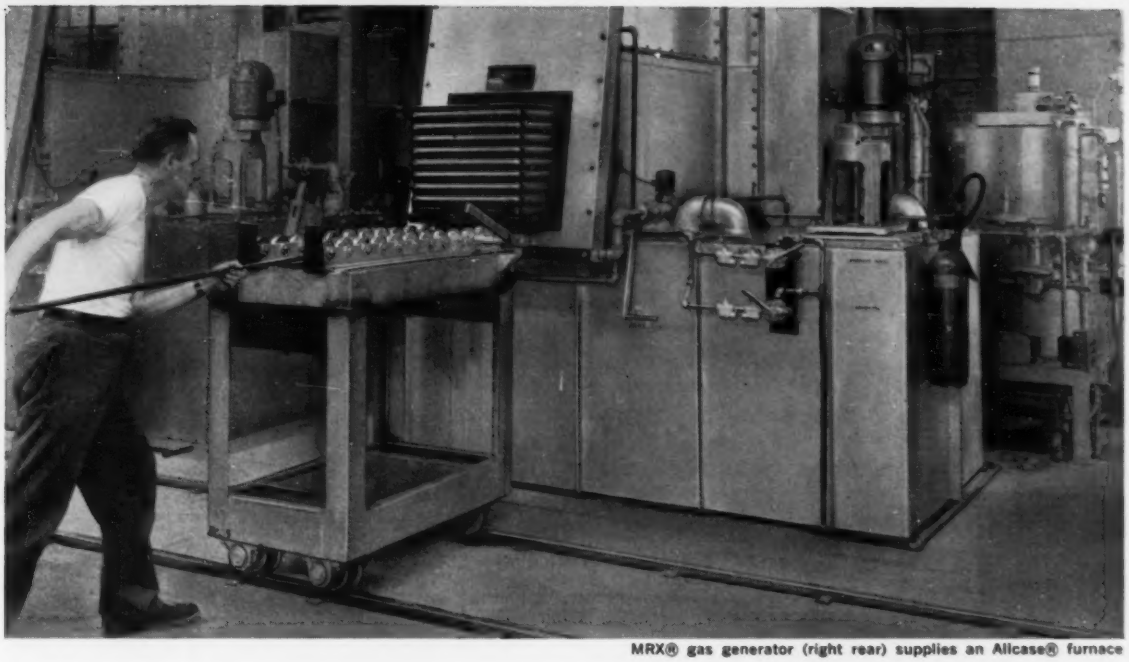
New types of endothermic gas generators which give positive control over a wide range of the hydrogen content of the atmosphere gas. New purifying equipments that can reduce the dew point of atmospheres to –150°F. This highly purified gas has been found to be particularly advantageous in certain special brazing operations. New automatic carbon potential controls with improved accuracy and lower cost are greatly expanding the use of automatic atmosphere controls for carburizing, carbo-nitriding, carbon restoration and homogeneous carburizing.

One of the most notable developments of the past years has been the growing use of steam heat treatment to powdered iron, cast iron, and the rehabilitation of tools after sharpening.

Proponents say that on sintered ferrous metals, hardness and compressive strength improve substantially by inexpensive steam treating. The uniform hard black iron oxide formed impregnates the compact and fills in porous cavities, which improves the general wear-resistant characteristics. Additionally, the oxide absorbs and stores oil, improving corrosion resistance.

Electric furnaces have been developed which have heating units operating at a voltage so low that they are not short-circuited by carbon or soot deposits. That means they can be installed directly in the heating chamber of carburizing furnaces obviating the use of expensive muffles. An interesting modification of this idea in the use of low voltage heaters is a furnace whose hearth in the form of a U-shaped ring forms the one turn secondary of a transformer. This ring performs the dual purpose of supplying the heat and conveying the material through the furnace. The

(Continued on page 38)



MRX® gas generator (right rear) supplies an Alcase® furnace

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CONSIDERATIONS IN THE HEAT TREATMENT OF TITANIUM-BASE ALLOYS

By **F. A. Crossley,** *Research Metallurgist*
and
D. W. Levinson, *Supervisor*
Armour Research Foundation
Chicago, Illinois

THIS discussion of the heat treatment of titanium-base alloys is intended for those readers with an acquaintance with titanium-base alloys who would like to know more about the why of their heat treatment and the factors which must be considered. No attempt is made herein to define specific heat treatments for specific alloys. The producers of titanium alloys are able and very willing to supply this kind of information. Commercial titanium-base alloys may be divided into two classes: (1) essentially single phase alloys consisting of the low temperature, hexagonal close packed, alpha (α) phase, and (2) two phase alloys consisting of mixtures of the alpha phase and the high temperature, body-centered cubic, beta (β) phase. Commonly used designations for the two classes are: for the single phase alloys—type A (for alpha), and for the two phase alloys—type C (for complex). Hereafter, these designations will be used to refer to the two groups. The more widely used commercial alloys are summarized in Table I. Except for softening by stress-relief annealing, mechanical properties of the single phase type A alloys cannot be changed by heat treatment. Consequently, this discussion is confined for the most part to the two phase type C alloys.

Although there are several good reasons why it may be desirable to heat treat titanium alloys, actually little heat treating outside of stress relief annealing is being done today. This is primarily due to the complexities associated with such heat treating.

TABLE I

SUMMARY OF THE MORE WIDELY USED TITANIUM-BASE ALLOYS

Trade Designation	Type	Composition, wt %	Yield Strength (0.2% Offset) psi Minimum	Typical	Producer*
A-55	A	Commercially pure	55,000	75,000	R-C
A-70	A	Commercially pure	70,000	90,000	R-C
Ti-75 A	A	Commercially pure (0.2 0-0.1N)	70,000		TMCA
RC-70	A	Commercially pure	70,000	82,000	R-S
MST Grade III	A	Commercially pure	70,000	80,000	M-S
A-110 AT	A	5A1-2.5Sn	110,000	120,000	R-C
C-110 M	C	8Mn	110,000	120,000	M-S, R-C & R-S
C-130 AM	C	4A1-4Mn	130,000	140,000	M-S, R-C & R-S
C-120 AV or Ti-6A1-4V	C	6A1-4V	120,000	130,000	R-C, R-S & TMCA
MST-6A1-4V	C	6A1-4V	130,000	140,000	M-S
Ti-140 A	C	2Fe-2Cr-2Mo	120,000		TMCA
RC-110 BX	C	2A1-3Mn	110,000	117,000	R-S
MST-3A1-5Cr	C	3A1-5Cr		145,000	M-S

*M-S—Mallory-Sharon Titanium Corp.
R-C—Rem-Cru Titanium Corp.
R-S—Republic Steel Corporation
TMCA—Titanium Metals Corporation of America

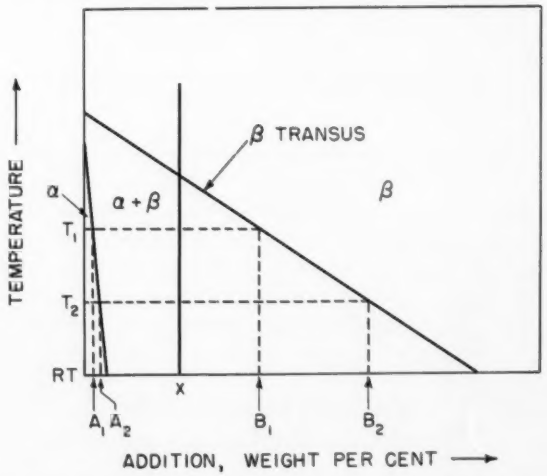


Fig. 1—Typical Binary Phase Diagram Produced by an Addition which Stabilizes the β phase and does not form a Compound with Titanium.

A typical titanium-rich end of a binary phase diagram obtained by adding a metal which produces the type C alloy is shown in Figure 1. The β transus separates the high temperature β field from the two phase α-β field. While Figure 1 is a schematic *binary* diagram, the phase relationships with which we will be concerned in actual ternary, quaternary, and even more complex alloys of the C type are essentially those shown in Figure 1.

The basic heat treatment of type C alloys consists of a solution heat treatment, a quench and an aging treatment. Solution heat treating should be done at temperatures below the β transus. Heating above the β transus produces in commercial alloys a structure illustrated by Figure 2 and results in a perma-

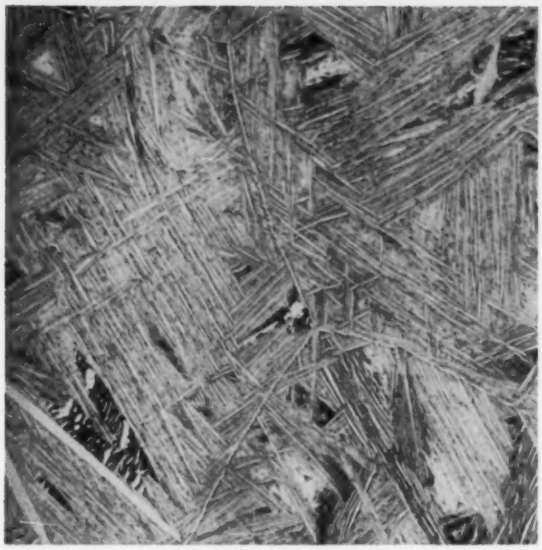


Fig. 2—Titanium alloy of C type heated above the β transus temperature and quenched into a lead bath at 1100°F. (X250)

nent loss in ductility that cannot be recovered by subsequent heat treatment. The upper temperature limit of the solution annealing range is defined at some temperature below the β transus where ductility in the fully solution heat treated and aged condition falls to marginal values.

The quench may be in water or air. The purpose of the quench is to retain the high temperature β phase. Upon aging at some temperature T_2, (see Figure 1) retained β of composition B_1 precipitates α of composition A_2, leaving β of composition B_2. Since the β phase is the phase which undergoes the strengthening reaction, the strength of an aged alloy increases as the relative amount of β increases. The relative amount of β increases with increasing solution heat

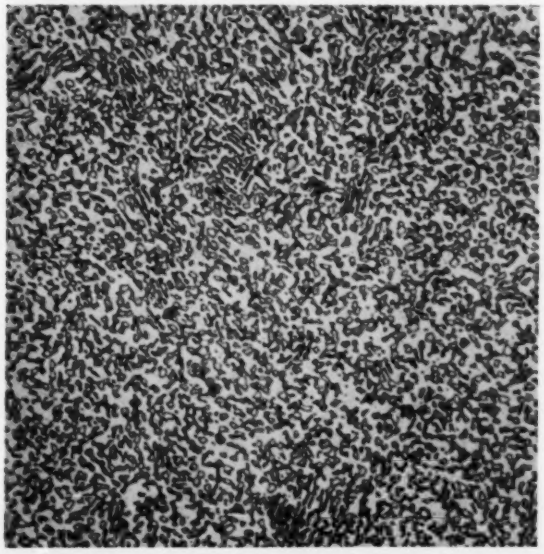


Fig. 3—Titanium alloy of C type reduced 75% by forging below the β transus temperature. (X750)

treating temperature to a maximum of 100 per cent at the β transus. Conversely, the potential for strengthening decreases with decreasing solution treating temperature until some temperature is reached where the fully heat treated condition does not differ significantly from the mill annealed condition. The practical lower temperature limit for solution treating would be somewhat above this temperature.

Water quenching retains more of the high temperature β phase than air cooling. Consequently, higher strengths are obtained by aging from a water quench than from an air cool. The β precipitation reaction is complicated by the occurrence of a transition phase at temperatures from slightly above room temperature to about 1000°F. The transition phase is called "omega" (ω). Its presence causes excessive hardening and embrittlement. The reaction is: $\beta \rightarrow_\omega + \beta \rightarrow_\alpha + \beta$. Aging treatments must be of sufficient duration to overage the precipitation reaction to insure that no ω phase remains. This is accomplished in shorter times, the higher the aging temperature. However, the higher the temperature at which aging, or more properly, overaging is done, the lower the strength. Therefore, considerations of maximum strength and practical aging times leads generally to aging temperatures in the range of 800° to 1000°F. Since, in general, present commercial titanium alloys are not considered for service above 750°F, overaging in the 800° to 1000°F range stabilizes alloys for elevated temperature application.

Maximum strength at room temperature does not necessarily mean maximum strength at elevated temperature, particularly in applications involving long times at elevated temperatures. Actually, there are very little data available on commercial alloys relating heat treated conditions to long time strength properties at elevated temperatures. The very limited data that are available indicate that high room temperature strength is consistent with high resistance to creep for temperatures up to 800°F and times less than 1000 hours.

Titanium alloy mill products are supplied with a structure similar to that shown in Figure 3. Properly heat treating this structure results in optimum combinations of strength and ductility. This structure is obtained by finishing the material below the β transus temperature. During fabrication, alloys should not be heated above the β transus unless sufficient finishing reduction is done below the β transus temperature to restore the preferred structure.

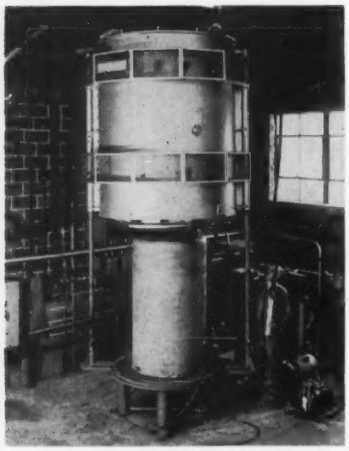
Formability can be brought into the heat treatment picture for the following reasons. Type C alloys containing aluminum (see Table I) water quenched from solution heat treatment temperatures exhibit lower yield strength and lower yield strength to ultimate tensile strength ratios than as mill annealed. Ratios of yield strength to ultimate tensile strength as low as 0.6 can be obtained by quenching from the

(Continued on page 33)

NEWS TO HEAT TREATERS...

VACUUM HEAT TREATING FURNACE

A new facility for vacuum or controlled atmosphere heat-treating is announced by NRC equipment Corporation of Newton Highlands, Massachusetts, a subsidiary of National Research Corporation. The NRC Model 2936 Vacuum Heat-Treating Furnace has a resistance heated uniform hot zone 36 inches in diameter and 36 inches high. The maximum working temperature is 2000° F. and minimum pressure 0.5 microns. To those whose vacuum heat-treating needs do not warrant the purchase of a vacuum furnace, NRC offers the services of the Model 2936 recently installed in its Newton Highlands plant.



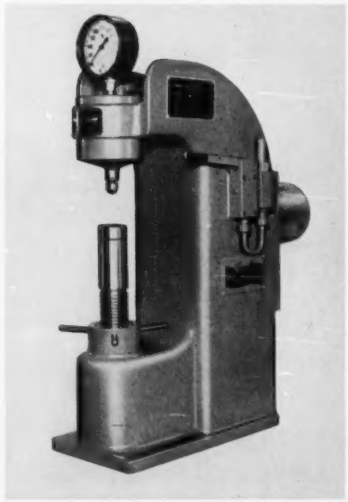
For many high performance metals and alloys, particularly reactive metals such as titanium and zirconium, annealing in a vacuum furnace not only provides optimum physical charactertistics but is often less costly than in atmosphere furnaces. It is said that the use of this furnace makes possible bright surfaces, assures reproducible results, prevents adverse changes in surface chemistry, and removes surface contaminants. It can be employed to restore the ductility of hydrogen-embrittled titanium and zirconium. The unit, introduced primarily to meet the demand for vacuum annealing titanium, is equally useful for sintering, brazing, hardening and degassing. The vertical arrangement of heating element and vacuum bell makes it suited for production operations where product handling is mechanized.

For further information circle No. 1

BENCH TYPE HARDNESS TESTER

A new low-cost motorized Brinell hardness tester, announced by Steel City testing Machines, Inc., Detroit, is said to combine operating economy with simple operation and dependable accuracy.

With this new bench model, Steel City offers, to all who require Brinell hardness testing, a motor-operated hydraulic machine with such outstanding features as fingertip load application, long stroke to eliminate anvil height adjustments, positive accuracy of loads well within A.S.T.M. Standards, and long dependable service with little maintenance required. The Brinell load, easily adjustable by turning a screw, is provided by a motorized hydraulic pump, with the oil reservoir contained within the machine frame. Operator ap-



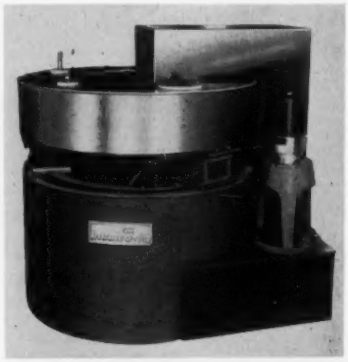
plies the load by depressing a lever on the side of the machine, holding it down for the desired time interval. Releasing the lever instantly releases the load.

The Model "L" is completely versatile for most normal Brinell hardness testing uses. Vertical opening is easily adjustable by turning a three-spoked elevating nut from a maximum 9" to a theoretical zero. Throat depth is 6". Load can easily be changed, if necessary, by merely turning a socket screw. The entire unit is compact, occupying an area of only 9" by 25".

For further information circle No. 2

FIRST INDUCTION HEATING HEAT TREATING FURNACE

An entirely new type of heat treating furnace was unveiled at the Metal Show by Lindberg Engineering Company. Called The Lindberg Induct-O-Ring, this radically different furnace is designed for carbonitriding, bright hardening, and carburizing of small parts.



For the first time in a heat treating furnace, the induction heating principle is used. The use of induction heating makes possible the complete elimination of any heating elements, element terminals, burners, gas or electric connections in the furnace proper.

Lindberg engineers state that a primary advantage of this furnace is its overall high heating efficiency and its spectacular heating rate, hardening temperatures being reached in 17 minutes from cold.

The operation of the furnace is automatic and extremely simple. The circular furnace has a reciprocating motion. It turns slowly in

the direction of work travel then quickly reverses. With each action the work remains in the forward position and regularly progresses through the chamber until it reaches a discharge chute.

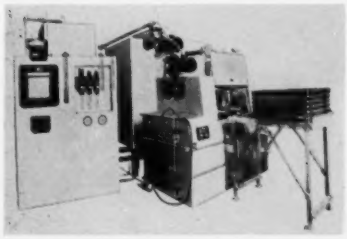
The circular shape provides a great saving in floor space. By using a double turn on the retort it is possible to have thirty feet of furnace length in a five foot diameter space. Actually, practically any chamber length within reason can be obtained by increasing the number of turns.

For further information circle No. 3

CONTROLLED ATMOSPHERE FURNACE

A new and improved version of the Sunbeam Stewart Casemaster controlled atmosphere furnace has recently been introduced by Sunbeam Corporation. The Casemaster, originally designed for batch-type operation of gas carburizing and carbonitriding, may also be used for clean hardening, martempering and controlled atmosphere annealing, because of its extreme flexibility.

This latest version is engineered to reduce the number of technically trained operators so that almost complete automation in operation is achieved. Temperatures once set are held uniform and the carbon potential is automatically maintained by a generator.



It is available in both gas and electrically-heated models. Each unit uses the radiant tube principle of heating. A true recirculating-type, high-temperature fan and accurately-controlled atmosphere provide the degree of consistency necessary to meet modern heat treating specifications.

For further information circle No. 4

NEW STEEL WAREHOUSE

The Alfred Heller Heat Treating Co. Inc., New York, N.Y., recently announced the formation of the Alfred Heller Steel Corp. of the same city. The new company has been set up to establish steel warehousing facilities for local users. Stocks consist of crucible tool, high speed and other special steels as well as Starrett's Oil and Air Hardening Ground Die Steel.

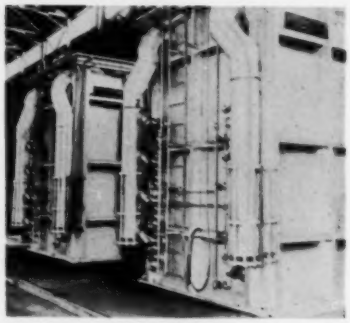
NEW SENIOR ENGINEER

Sunbeam Corporation, Chicago, announced recently the appointment of John P. Zur to the capacity of Senior Engineer.

A graduate in the 1934 class at Ohio State with a B. S. Degree in Metallurgical Engineering, Mr. Zur was the Metallurgical and Chief Engineer with the Tauwood Engineering Company from 1935 to 1951. He later joined Lee Wilson Contracting Company as Production Manager from 1951 to 1954. Returning to Tauwood Engineering Company as a Vice-President in 1954, he recently joined Sunbeam Corporation as a Senior Engineer with the Industrial Furnace Division. Since 1935 he has been engaged in the design and construction of wire and strip heat treating equipment.

SILICON STEEL

The rising demand for silicon steel has resulted in a substantial increase of facilities for the production of this grade of steel.



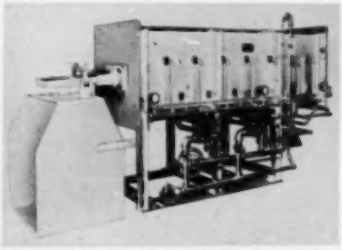
Silicon steel is used extensively in the construction of electrical equipment and demand for it has practically trebled in the past ten years.

Loftus Engineering Corporation of Pittsburgh has recently finished installation of ten cover type annealing furnaces with twenty-seven bases at the Vandergrift Works of the United States Steel Corporation.

NEW INVENTION AND PATENT

U. S. Patent No. 2,726,354 for improved heat treating equipment has been granted to Mr. Philip C. Osterman, President of American Gas Furnace Co., Elizabeth, N. J.

The invention relates generally to heat treating furnaces and apparatus useful in the treating of relatively small work-pieces and is concerned with improvements in the means for conveying the work step by step from a loading station outside the furnace through the heating chamber of the furnace.



A primary aim of the invention is to distribute the work evenly over the furnace hearth.

An illustrated bulletin giving more specific information is available.

For further information circle No. 5

NEW BLAST CLEANING ABRASIVE

A new steel grit blast cleaning abrasive, for producing etched finishes, is announced by Wheelabrator Corporation, Mishawaka, Indiana.

Known as Steeletts, this grit is of high-carbon electric arc furnace steel, specially heat treated to provide the toughness required for blast cleaning operations. It is in the same hardness range as chilled iron abrasives. Steeletts, however, are free from the brittle carbides which cause rapid breakdown of chilled iron. Steeletts particles do not chip away upon impact. The grit shape endures for hundreds of cycles without the sharp edges that are caused by fracturing. Lack of these cutting edges reduces blast cleaning machine wear and maintenance. Abrasive embedment in the work is reduced.

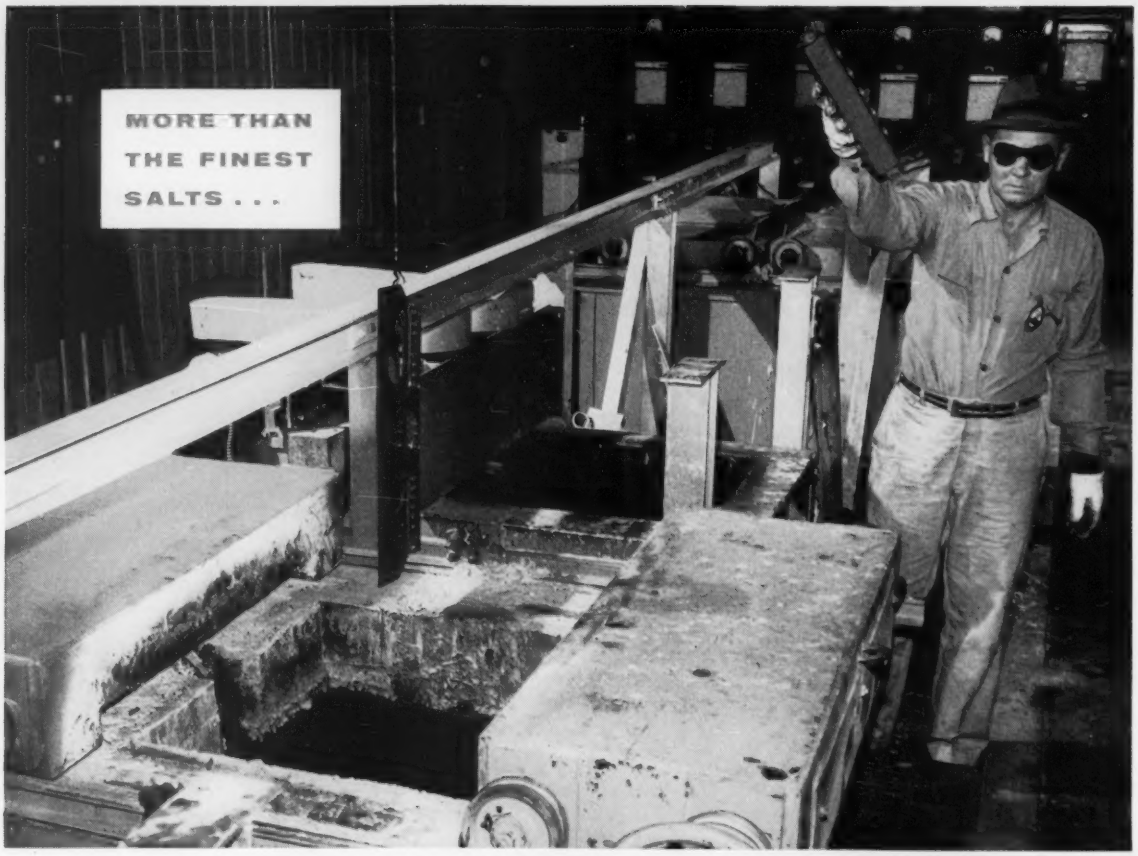
Steeletts are available in seven sizes, ranging from G-16 down to G-120. All are screened to SAE size specifications. They are packaged in strong 50-pound fiberboard cartons. Fiberboard resists punctures to a greater extent than paper liners used in conventional burlap grit bags, and the cartons are considerably stronger than the burlap itself. Having only half the weight of the conventional bag, cartons are also easier for workmen to handle when charging any type blast cleaning machine. The shape of a carton reduces spillage during pouring.

For further information circle No. 6

NON-FLAMMABLE SOLVENT

Immunol, a neutral, non-toxic, non-flammable solvent that cleans, degreases and rustproofs all metal

(Continued on page 19)



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Houghton's long experience and wide knowledge of heat treating are at your service. Ask your Houghton Man or write direct to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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Ready to give you on-the-job service . . .

NEWS TO HEAT TREATERS

(Continued from page 16)

surfaces safely and effectively in one operation is being offered by Harry Miller Corp., Philadelphia 40, Pa. The inexpensive product is harmless and can be applied by any method now in common use to clean anything from small parts to heavy machinery. Immunol, mixed with hot or cold tap water, is said to be superior to carbon tetrachloride, trichlorethylene, kerosene, mineral spirits and gasoline and it quickly carries off oils, soils or foreign matter, leaving a protective rustproof coating. Only a few ounces of the solvent per gallon of water are required to produce a gallon of solvent which can be used over again for many applications once the foreign matter has been removed.

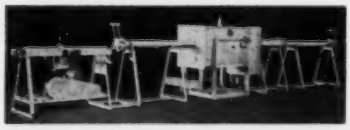
It can be used: in vapor degreasing units; for improving alkali cleaners; as a rust preventive; for the final rinse after plating; for tumbling operations; for machine shop applications; to increase tool life and improve machining operations; to remove gum deposits in oil operated hydraulic and lubricating systems and for quenching and hydrostatic testing.

For further information circle No. 7

5000F. CARBON TUBE FURNACE

Continuous carbon tubular element furnaces with tube sizes up to 6" I.D. are now available from the Harper Electric Furnace Corporation, Buffalo, N.Y., manufacturers of high temperature industrial electric furnaces and kilns.

First announced by Harper for high temperature research several years ago, this type of furnace permits uniform heating of work with-



in a graphite tubular resistance element in which temperatures up to 5000° F. can be indefinitely maintained.

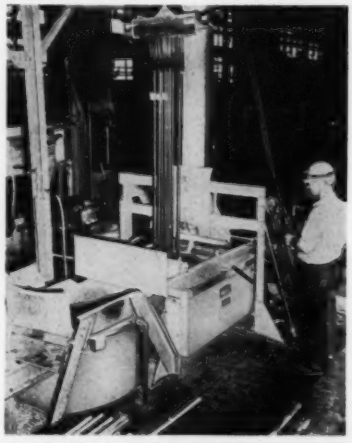
In addition to increased tube sizes, the new furnaces feature continuous operation with automatic mechanical pusher, entrance preheating chamber, and water-cooled cooling chamber. Purge chambers may be added to maintain low dew-point reducing atmospheres. Quick-opening end compartments permit easy tube replacement.

Overall length of the largest unit is 28 feet. Research models with tube diameters down to 1" are also available.

For further information circle No. 8

HEAT TREATING CHROMIUM-COPPER BARS

Mueller Brass Company, Port Huron, Michigan, manufacturers of brass and bronze forgings in almost any shape or size, are shown solution heat treating ½" to 2" diameter chromium-copper alloy rods up to twelve feet long without distortion. Formerly a problem



when the bars were heat treated horizontally, distortion has been overcome by heating the bars *vertically* in a salt bath furnace made by Ajax Electric Company, Philadelphia, Pa.

Despite the extreme depth of the furnace, which has top working dimensions of 15" x 15" and is almost 15 feet deep, temperatures anywhere within the bath are within 10°F of the control setting. This is possible because of the self-circulating action of the four pairs of submerged electrodes which enter the furnace at four different levels.

For further information circle No. 9

DEGREASING BASKET

A new basket made for use in the degreasing and annealing furnace, is constructed of #16 gauge corrosion-resistant Monel metal throughout, according to the Wiretex Manufacturing Company, Inc., Bridgeport, Conn.

Monel possesses useful resistance to corrosion by all the common organic acids, and is practically free from corrosion by neutral and alkaline organic compounds.

Size of the basket is 21½"x13½" x 13½" deep. Sides and bottom are of ½" hole #16 gauge perforated Monel. The top and bottom frame is of 1" x ⅛" flat bar stock, while the corner braces are of 1" x 1" x ⅛" angle Monel. Handles at each end, made of ⅜" diameter rod, are shaped for quick, easy, comfortable gripping.

For further information circle No. 10

NEW QUARTERS

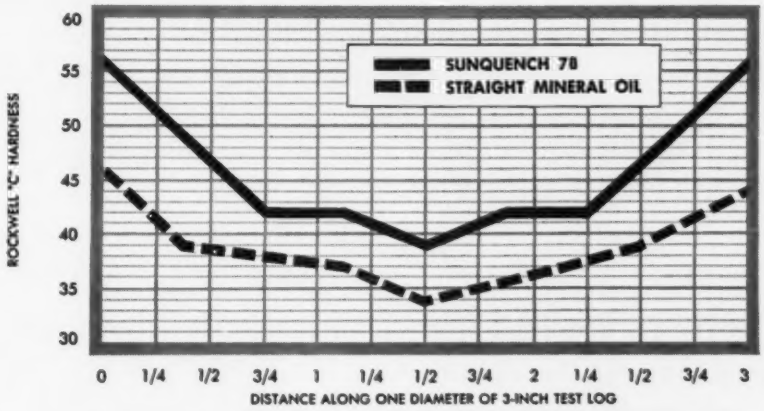
Gas Appliance Service, Inc., manufacturers of industrial heat processing equipment, are moving into new, modern quarters at 1940 Balmoral Avenue, Chicago 40, Illinois.

They have been in the field for many years and are widely known for the designing and manufacture of a broad line of gas-fired production machines for brazing, soldering, flame hardening, annealing, and forging—all incorporating the G.A.S. principle of high speed heating. Also included in the line are heat treating furnaces, air heaters, and ovens.

For further information circle No. 11


NEW! FAST! LONG LASTING!...
A new high-speed quenching oil
with an extra-long service life

....SUNQUENCH 78



Three-inch test logs of AISI 4140 were quenched in both SUNQUENCH 78 and a conventional quenching oil. The graph shows the results.

SUNQUENCH 78* was developed for those tough quenching jobs where a conventional quenching oil can't give you satisfactory results. For example:

Easily distorted parts can be satisfactorily quenched in SUNQUENCH 78. It rapidly wets out all surfaces and produces a uniform quenching action.

Baskets of tightly packed parts can be quenched more uniformly because of the efficient cooling action of SUNQUENCH 78.

Baths with inadequate agitation frequently can't develop full hardness with conventional quenching oils. Here again, SUNQUENCH 78 is the answer.

Steels of low hardenability, which have been substituted for more expensive alloy steels, develop maximum hardness and strength when they are quenched in SUNQUENCH 78.

The long service life of SUNQUENCH 78 is just as important as its high-speed quenching action. Special inhibitors give SUNQUENCH 78 an exceptionally high thermal and oxidation stability. Even at abnormally high quenching-bath temperatures, SUNQUENCH 78 has very little tendency to thicken-up or form cooler-clogging sludge.

For more information on new SUNQUENCH 78, and other Sun Quenching Oils, see your Sun representative or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. MR-11.

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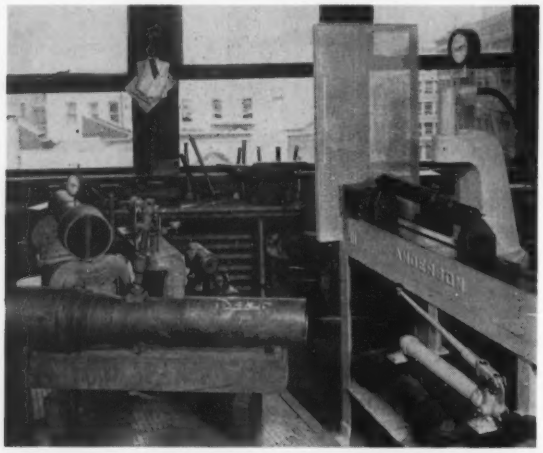
THE APPRENTICE CORNER

STRAIGHTENING

The use of a jig or fixture clamping device to correct the warp or distortion during the tempering process of a hardened steel part is generally termed temper straightening. In this procedure the resultant straightening or distortion correction is the result of the relief of the stresses accompanying the transformation from austenite to martensite during the quenching cycle, and in those cases of tempering to low hardness levels is the result of the change from martensite to structures known as troostite and sorbite.



Two examples of straightening techniques are illustrated here: (Left) SAE 4340 steel to be oil quenched, stress tempered, and indicated for runout. It is jigged and tempered to specifications within .010" Total Indicated Reading. (Right) Oil Hardening tool steel to be hot salt quenched and straightened while hot within .010" Total Indicated Reading jigged and tempered to RC 60-62 and within .005" T.I.R.

Fixture straightening (Sept.-Oct. issue p. 36) when used in conjunction with tempering in the proper fixtures can result in very close tolerances. Tool steels of all types can be hardened and tempered by the methods described with maximum hardness values and minimum distortion.

High strength alloy steels requiring physical properties ranging from 125,000 psi upwards are subjected to the same straightening techniques. In some cases these alloy steels are oil quenched to 150°F. or quenched in hot salt at a pre-determined temperature. The choice depends on the size, shape, or alloy composition.

For those parts requiring strength levels of 180,000 psi or lower, oil quenching and stress tempering before clamping in a fixture for distortion correction and final tempering to specifications will often suffice. For very high strength levels and greater complexity of the part, or both, the use of the two methods, straightening during transformation and temper straightening, may often be necessary.

Fred Heinzelman, Jr., Fred Heinzelman & Sons

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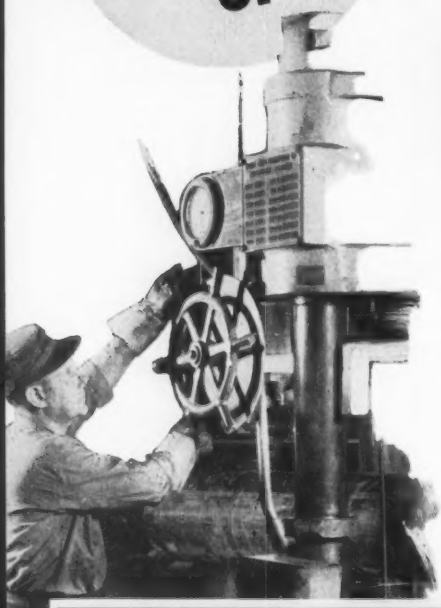

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Today's modern commercial heat treating plant might well be described as a "department store" for metal treating services. For under one roof are offered you not only the full range of heat treating equipment for all types of processes . . . but . . . of still greater importance, the manpower skills of the management and technicians of those supervising and performing your jobs. *Service* is their keynote.

Whatever your needs . . . whenever you need it . . .

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Cook Induction Heating Co.
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Metal Treating & Research Co.
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Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 12

ILLINOIS

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Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
Dura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
Pearson Industrial Steel Treating Co.
5757 W. Ogden Ave., Chicago 50
Perfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22
Fred A. Snow Co.
1942 West Kinzie St., Chicago 22
American Steel Treating Co.
P. O. Box 225, Crystal Lake
Eklund Metal Treating, Inc.
721 Beacon St., Loves Park
Lindberg Steel Treating Co.
1975 N. Ruby St., Melrose Park
O. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
C. U. Scott & Son, Inc.
1510 First Ave., Rock Island

MARYLAND

Maryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

New England Metallurgical Corp.
475 Dorchester Ave., South Boston 27
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
Metallurgical Processing Company
2703 East Nine Mile Road, Hazel Park
Royal Oak Heat Treat, Inc.
21419 Dequindre, Hazel Park
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1727 Manchester Ave., Kansas City 8
Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Metal Treating Corp.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark 5
Temperature Processing Co., Inc.
228 River Road, North Arlington

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1273 East 55th Street, Cleveland 3
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West 3rd St., Lansdale
Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Dominy Heat Treating Corp.
P. O. Box 5054, Dallas
Superior Heat Treating Co., Inc.
P. O. Box 1686, Fort Worth 1
Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11
Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

WISCONSIN

Allied Metal Treating Corp.
830 S. Fifth St., P. O. Box 612, Milwaukee 1
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wisconsin Steel Treating & Blasting Co.
1114 South 41st Street, Milwaukee 15
Harris Metals Treating Co.
4100 Douglas Ave., Racine

CANADA

B. & W. Precision Heat Treating Co.
70 Borden Ave., S., Kitchener, Ontario

METAL TREATING INSTITUTE

271 NORTH AVENUE, NEW ROCHELLE, N. Y.

SALT BATH POT LIFE

(*Continued from page 8*)

duction capacity. Others had to be so thick (because of the way they were made) that heat flow was low at all times. Also, they were subject to cracking because of internal stresses.

As a result of either scale or internal strain, all previous types of pots had a tendency to fail without warning, dumping salts into the furnace. This usually meant an expensive rebricking job on gas and oil fired furnaces, or replacing heating elements on electric types.

This is precisely what happened at Eastern Heat Treating and Brazing Corporation, one of the companies reported in Table I. Then, the company installed an Inconel nickel-chromium alloy pot which

After beveling, the heavy Inconel sheet is rolled into a cylinder to form the body of a pot.

was made by Rolock, Inc., Fairfield, Conn, and marketed under the trade name "Neu-Pot". It is still in good condition after almost 4000 hours of service. Equally important is the fact that there is little danger of this Inconel pot failing without adequate warning. Ultimately, a pinhole will probably develop, allowing salt to leak through the wall. This will produce sparks or smoke in the furnace exhaust and be detected readily by the operator.

Another advantage of the fabricated Inconel pot is that the wall thickness is relatively thin. The rate of heat transfer is always high, thus conserving heat and increasing production capacity. The K.L.K. Manufacturing Company, for example, reports that their Neu-Pot now gives them quicker recovery without any drop off throughout the service life of the pot. In the past, they were troubled with poor recovery a week or two after installing a new pot.

Success of the Neu-Pot is attributed to a combination of proper selection of materials and carefully controlled fabrication. Inconel plate, sheared to length, is rolled into a cylinder and welded to form

Welding is critical for long life. For best properties, Relock uses shielded arc process with Inconel welding wire. During fabrication welds are inspected with dye penetrants and after lubrication, the entire pot is inspected with X-ray equipment.

the body. Bevel angle of the plate is rigidly controlled and mating surfaces are scarfed prior to welding.

A semi-elliptical dished head is added to the body to form the bottom of the pot. Again beveling and scarfing assure high quality joints. In addition, all welding is done by the inert gas-shielded arc process, using Inconel welding wire. Between passes, joints are wire brushed, intermediate checks are made with dye penetrants, and as a final precaution, all joints are inspected with X-ray equipment. Inspection standards are rigid—equivalent to aircraft welding specifications. As a result, of all the installations made to date there has been not one report of a failure at the weld.

Because of the many variables involved, there can be no satisfactory measure of acceptable life of salt pots. Under all conditions, however, maximum life will be achieved only by following these nine suggestions:

1. *GUARD AGAINST SULPHUR* both inside and outside of pot. Even small amounts of sulphur embrittle Inconel and will cause cracking of the pot. For longest life, oil used for fuel should not contain more than 0.5% sulphur by weight. Materials used for bricking the furnace or cementing the pot in place should have as low a sulphur content as possible.

2. *AVOID CONTAMINATING THE SALT.* Foreign materials such as cutting oils, broaching compounds, sulphurized free machining steel chips, or other sulphur-bearing materials must be kept out of Inconel salt pots. Also, materials such as soaps or other substances containing sodium oxide or lime must be kept out to keep from decarburizing the work. Clean work not only safeguards the pot, but helps keep the bath neutral.

3. *AVOID FLAME IMPINGEMENT.* Multiple tangential burners are preferred for heating. If flame impingement cannot be avoided, rotate the pot 90 degrees each week to minimize damage.

4. *KEEP SALT OUT OF COMBUSTION SPACE.* Seal the flange of the pot to the top of the furnace to be sure that no salt gets into the combustion chamber. Salt breaks down and is very corrosive at the high temperature of the furnace gases.

5. *CONTROL TEMPERATURE CAREFULLY.* An increase of only about 50 degrees above recommended values may cut life in half. Heat the bath slowly, to avoid excessive temperature on the outside of the pot. Check temperature at frequent intervals. Two thermocouples—one in the salt and the other in the combustion chamber give a more certain control of outside as well as inside pot temperatures.

6. *DO NOT OVERLOAD THE POT.* Do not exceed the recommended ratio of work to salt. Overloading causes excessive temperatures in the burner chamber while the pot temperature is recovering, and overshooting when the burners turn down.

7. *REMOVE SLUDGE FREQUENTLY.* Rectifiers are necessary to keep the salt bath neutral. Sludge should be removed daily to avoid overheating the bottom of the pot.

8. *KEEP THE SALT MOLTEN* at its idling temperature between operating periods. The increased pot life obtained by avoiding freezing and remelting will more than pay for the cost of fuel for idling.

9. *CLEAN SALT FROM FURNACE.* When a pot develops a leak remove it promptly, and reline or thoroughly remove all salt from the furnace chamber. Never replace a pot in a furnace chamber containing salt because the products of combustion of the salt are corrosive and will reduce the life of the pot. ■■■

Removing a load of small parts from a neutral salts bath furnace at K.L.K. Manufacturing Company. Like Eastern Heat Treating & Brazing Co., K.L.K. had been troubled with premature and unpredictable failures of their salt pots until they installed one fabricated from Inconel plate.

Right Or Wrong In

LABOR RELATIONS

Editor's Note: *This department presents, in each issue, a round-up of day-to-day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

Can You Discharge An Employee Who Does Not Want A Promotion?

What Happened:

Max Looper wasn't a ball of fire, but for four years he did a fair job. One day Looper was promoted to a job of final inspector—and he was unhappy about it. "This is a pressure job," he told his foreman, "and I'm afraid I can't handle it." The foreman gave no heed to Looper's anxiety. It soon became evident that Looper's fears were well founded. In a year he made four costly errors, and he was fired. He protested:

1. I told my foreman I couldn't handle more responsibility.
2. If I didn't make good, I should have been transferred to a job which is "emotionally suitable" for me.

The company came back with these arguments:

1. We are not in the psychiatry business. If a man can't handle responsibility, that's not our fault.
2. We can't retain people who want to stay in a rut. If we did, our business would stagnate.

Was the Company: RIGHT □ WRONG □

What Arbitrator Langston T. Hawley Ruled:

"It is the arbitrator's conviction that the pressure under which Looper was working as a final inspector is that to which any employee is subject when he is doing a job he did not want in the first place and for which he is not particularly suited by experience or temperament. Looper's unrefuted testimony reveals that he had certain anxieties about his work as an inspector which help to explain the deficiencies in his performance.

"In view of the foregoing circumstances, it is the arbitrator's opinion that the company, instead of discharging the grievant, should have made a greater effort to transfer him before permitting his work errors as an inspector to become so numerous. Certainly the mutual interests of the parties would have been better served by transferring Looper to more suitable work. Accordingly, it is the arbitrator's judgment that Looper should be reinstated by the company."

Can You Fire An Employee For Defending Himself In A Fist Fight On Company Property?

What Happened:

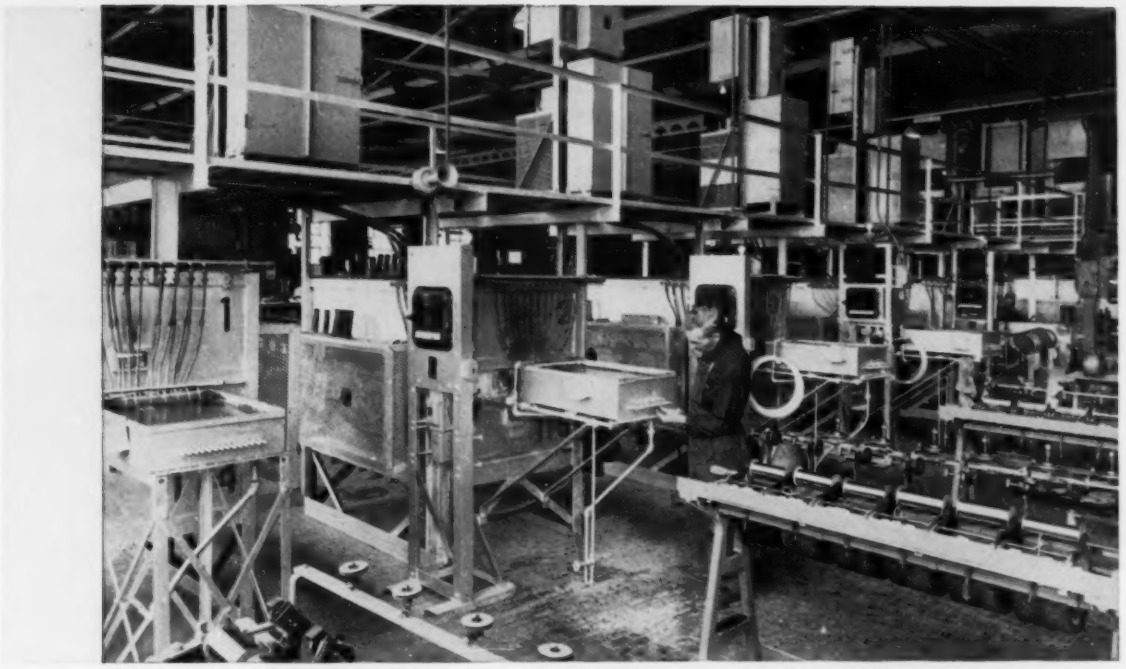
Sam Edon worked in the shipping department. When a company truck backed into the loading platform, Edon yelled: "Hey, you mug, you can't park there."

The driver, Jim Forrest, took this as an insult and jumped out, fists flying. Edon, who was no powder puff, took up the challenge. The fight lasted for over 15 minutes, with both men slugging it out. They threw not only fists, but hammers, boxes and chains. It was a real battle—Hollywood style. Edon won, but his reward was a discharge notice. Forrest got one, too. Edon protested: "I didn't start the fight—I simply defended myself."

The company agreed that this was so, but maintained that it was Edon's duty to fend off Forrest's blows and not to indulge in a lengthy battle, using company equipment as ammunition.

Was the Company: RIGHT □ WRONG □

(Continued on page 46)



Now Completely Equipped With "Hot Rods." Part of a battery of nine electric strand bright annealing furnaces at the Dunkirk, N. Y., plant of Allegheny Ludlum Steel Corporation. Wire is annealed in these furnaces in alloy tubes containing a dissociated ammonia atmosphere. Operating temperature averages 2200°F. Furnaces are shut down after a five- or six-day working week.

Why Allegheny Ludlum converted to "HOT RODS"

Leading steel manufacturer reports longer life, improved performance, with CRYSTOLON heating elements*

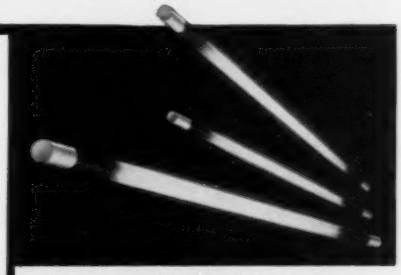
Allegheny Ludlum Steel Corporation hoped to improve the varying performance and service life of the heating elements originally installed in their electric wire-annealing furnaces.

So, they converted all nine furnaces completely to Norton "Hot Rods" — and got the improvements they wanted from the very start. For example, one set of "Hot Rods" was recently removed after 10,000 hours of trouble-free service.

Proved "Hot Rod" Advantages

Many plants report Norton CRYSTOLON heating elements outlast other non-metallic heating elements *up to 3 to 1!* This much longer life means savings in element costs, because fewer "Hot Rods" are needed. Also, you get reduced maintenance, due to less changing of elements or voltage taps. And "Hot Rods" help protect product quality because their slow, evenly matched rate of resistance increase means more uniform heating.

The big illustrated booklet, *Norton Heating Elements,* gives further facts on how "Hot Rods" can help improve your furnace operations and cut costs. For your copy write to NORTON COMPANY, Refractories Division, 630 New Bond Street, Worcester 6, Massachusetts.



Norton CRYSTOLON Heating Elements, or "Hot Rods," are a typical Norton Rx — an expertly engineered refractory prescription for greater efficiency and economy in electric kiln and furnace operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes.

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed
Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING PRODUCTS: Coated Abrasives Sharpening Stones • Behr-cat Tapes
*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

HEAT TREATING HELP

THE CARPENTER STEEL COMPANY, 198 W. Bern St., Reading, Pa. No. 2 in a series

TIME REQUIRED TO REACH THE DRAWING HEAT

As you know, hardened tools are *drawn* or *tempered* at low temperatures where the unaided eye cannot "see" the heat. How long does it take a tool to uniformly reach the drawing heat? This is important because when recommended drawing procedure in the Carpenter Matched Tool and Die Steel Manual says, "Draw for one hour", it means that the tool should be *soaked* for one hour *after* it gets up to heat. The following table will guide you in estimating the probable time needed to reach the drawing temperature. It is assumed that the drawing furnace or bath is being maintained as steadily as possible *at* the proper drawing temperature.

". . . it is assumed that the bath is maintained at the proper temperature."

APPROXIMATE TIME TO REACH DRAWING TEMPERATURES

In a hot air oven, without forced circulation

Drawing Temperature	Approximate Shape of the Tool†		
	Cubes or Spheres	Long Squares or Cylinders	Average Flat Tools
300° F.	30 minutes per inch of thickness	50 minutes per inch of thickness	90 minutes per inch of thickness
400° F.	25 minutes per inch of thickness	45 minutes per inch of thickness	65 minutes per inch of thickness
500° F.	25 minutes per inch of thickness	40 minutes per inch of thickness	60 minutes per inch of thickness
700° F.	20 minutes per inch of thickness	35 minutes per inch of thickness	50 minutes per inch of thickness
900° F.	20 minutes per inch of thickness	30 minutes per inch of thickness	40 minutes per inch of thickness

In a circulating air oven, or an oil bath*

Drawing Temperature	Approximate Shape of the Tool†		
	Cubes or Spheres	Long Squares or Cylinders	Average Flat Tools
300° F.	15 minutes per inch of thickness	20 minutes per inch of thickness	30 minutes per inch of thickness
400° F.	15 minutes per inch of thickness	20 minutes per inch of thickness	30 minutes per inch of thickness
*500° F.	15 minutes per inch of thickness	20 minutes per inch of thickness	30 minutes per inch of thickness
700° F.	15 minutes per inch of thickness	20 minutes per inch of thickness	30 minutes per inch of thickness
900° F.	15 minutes per inch of thickness	20 minutes per inch of thickness	30 minutes per inch of thickness

* Oil baths should not be used above about 500° F.

†Regarding *shape*—a form tool 3" dia. x about 3" long would be "like a sphere". Since it measures 3" thick, it would require about 75 minutes to reach 400° F. in a hot air drawing oven *without* forced circulation. A reamer would be "like a long cylinder"; and a blanking die measuring 4" x 1½" x 8" would be an "average flat".

In this issue of "Heat Treating Helps" we have discussed the "Time Required to Reach the Drawing Heat". In future issues of this magazine we plan to continue the discussion, outlining additional data on considerations such as "Hardening Furnace Atmosphere", "Quenching Procedures", "Torsion Impact Test as a Guide to Better Heat Treating Results", etc.

LETTERS TO THE EDITOR

Dear Editor:

I have just received the September-October issue of METAL TREATING magazine and have just noticed the picture on the cover of the F.W.D. heat treat department and my article on the relative importance of the material selection to the metal treater.

I would like to take this opportunity to compliment you on the splendid arrangement of the article. I sincerely hope it will carry a message of practical interest to your readers.

JAMES SORENSON
Chief Metallurgist
The Four Wheel Drive Auto Co.
Clintonville, Wis.

Dear Editor:

Our firm is one of the biggest constructors of industrial furnaces in France. Our Documentation Service has found a lot of interesting articles in your very excellent publication and we dare to ask you if it would be possible for you to send us the following copies of your review:

METAL TREATING Sept.-Oct. 1954

All the issues of 1955.

We would be very happy to receive your publication regularly in the future and so we ask you to let us know the subscription rate.

J. C. PETO
Documentation Service
Societe Anonyme Heurtey
PARIS, FRANCE

Dear Editor:

Will you send us a sample copy of your journal METAL TREATING 1956, May-June.

LARS G. LINDQVIST
Allmanna Svenska Elektriska Aktiebolaget
VASTERAS, SWEDEN

Dear Editor:

The article, "The Heat Treatment of Steel" which appeared in the September-October issue of METAL TREATING was read with considerable interest here at Ipsen Industries. It is exactly the sort of thing we need for indoctrination of personnel who have had little contact with heat treating.

May we have a dozen tear sheets of the article?

R. J. JEFFRIES
Ipsen Industries, Inc.
Rockford, Ill.

Dear Editor:

Please send us three (3) copies of your eight-page booklet entitled "How to Avoid Heat Treating Difficulties Through Correct Design of Press Tools."

Thank You.

E. J. GORSE
Tool & Process Engr. Department
Packard Electric Division
General Motors Corp.
Warren, Ohio

Tool Steel Topics

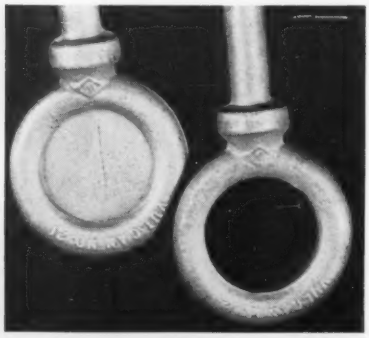
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Bearcat Puts the Eye in Eye Bolt . . . And Does It Economically

Putting the eye in an eye bolt is one thing, but doing it quickly, accurately and economically on thousands of pieces is something else again. J. H. Williams & Co., Buffalo, who make wrenches, tools and drop-forgings, changed to Bearcat for the punching operation shown here. They found that because of Bearcat's fine wear-resistance and shock-resistance, the punch provided a service life about 50 pct longer than the one previously used.



The Bearcat punch, hardened to Rockwell C 56-58, works on steel stock ⅛ in. and 5/16 in. thick, and knocks out discs approximately ¾ in. in diameter. About 0.020 in. to 0.040 in. is removed in occasional redressing.

Bearcat is our super-tough, air-hardening, general-purpose grade of tool steel. It is perhaps best known for its exceptional resistance to shock and wear. Besides, its air-hardening characteristic minimizes quenching hazards, and also provides excellent resistance to distortion in heat-treatment.

Bearcat has a wide range of tough applications, too. In addition to its use in punches, it's a natural for rivet sets, chisels, gripper dies and hot-headers. It is also ideal for master hobs, and for dies used in blanking, bending, and cold-forming.

Your local tool steel distributor has a stock of Bearcat, and chances are good that he can furnish exactly what you need. Call him now, while you have it in mind.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Choosing the Grade Means More Than Naming the Tool

Let's say you have a general tool-and-die application, for which you are to select the proper grade of tool steel. How do you go about it? Obviously, it is not enough to know that the customer wants high hardness and good wear-resistance, for these properties are always required, in some degree. What you need are the answers to the following questions:

1. How is the tool to be made?
2. How is it to be used? Blanking? Forming? Cutting?
3. How is the steel to be heat-treated?
4. Are machinability and wear-resistance important?
5. How close must size be held after heat-treatment?
6. What is the previous experience with this job? Which steels were used and what results were obtained?

Selecting tool steel grades, even when you want perfection of operation, isn't too hard when sufficient data is available. But without adequate information, you may find your selection is disappointing.

TOOL STEEL MOVIE WINS ANOTHER AWARD

Bethlehem's tool steel color movie, "Teamwork," an award winner at film festivals at Columbus and Chicago, recently won a Certificate of Merit at the Cleveland Film Festival.

The 16-mm, 30-minute picture explains the quality control and heat-treatment of Bethlehem tool steel, and shows typical applications of the carbon, oil- and air-hardening, shock-resisting, hot-work, and high-speed grades.

It's excellent for showing to heat-treaters, die-makers, machinists and machine-tool manufacturers, as well as to technical societies and engineering students. If you would like to schedule a showing of "Teamwork," send your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

TITANIUM-BASE ALLOYS

(*Continued from page 13*)

optimum solution temperature. Therefore, there is the distinct possibility of facilitating forming operations which are carried out between the solution and aging heat treatments.

The advantages of applying solution and age heat treatments are offset to some extent by associated technical difficulties. For example, heating to temperatures of the order of 1300°F and above unless done under vacuum or inert atmosphere results in the formation of scale and a hard layer of material immediately below the scale. This layer is commonly called "alpha" case and is the result of oxygen diffusion from the air into the metal. Both the scale and the alpha case must be removed if ductility is not to be seriously impaired. The scale can be removed by grit blasting or by immersing in certain molten salt baths. The alpha case is removed by pickling, commonly in aqueous hydrofluoric and nitric acid solutions. Hydrogen pickup from pickling baths is a constant source of concern. Although pickling operations can be controlled to keep hydrogen absorption within acceptable limits, present methods leave much to be desired. Hydrogen, when present in many titanium alloys in quantities exceeding 125 parts per million by weight, has generally detrimental effects on ductility and stability.

Water quenching, particularly of sheet products, presents problems of distortion. Ideally, sheet would be supplied by producers in the solution annealed and quenched condition. In order to do this, in addition to the problems of descaling and removing the contaminated surface, producers would have to solve the problem of straightening the sheet without introducing too much cold work.

Another consideration in favor of the solution treat and age type heat treatment over the mill annealed condition for type C alloys is that in principle it results in a more stable condition for elevated temperature application. However, there are no data to show that this is the case in practice.

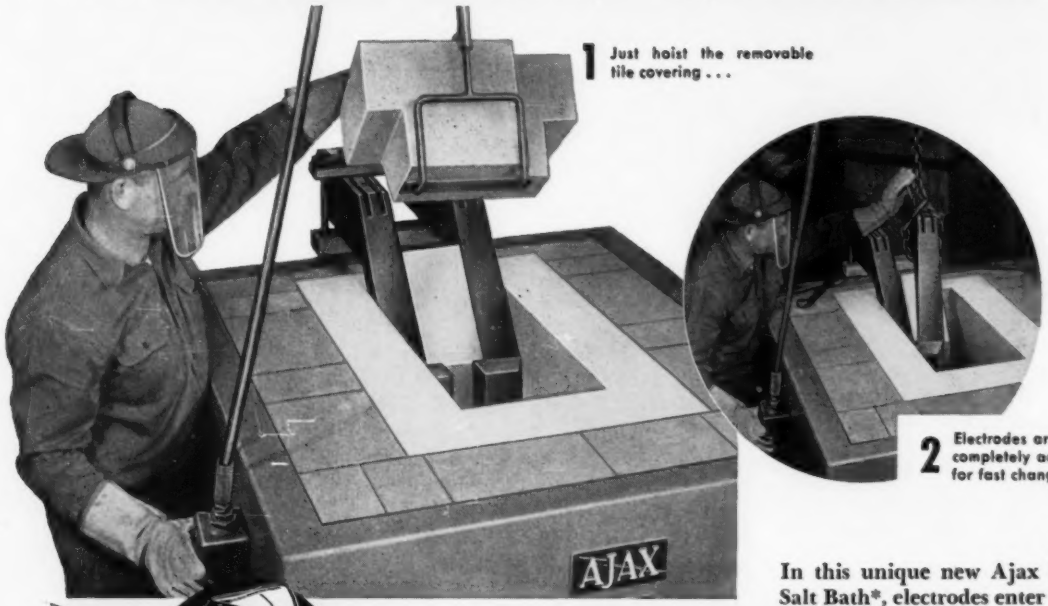
SUMMARY AND CONCLUSION

Stress relief-type heat treatments are applied to both type A and type C alloys. While type C alloys can be heat treated to increase strength properties, very little heat treating to achieve this objective is done today. Strengthening heat treatments are of the solution treat and age variety with solution treating taking place at a high temperature in the α-β field and aging at a relatively low temperature in the α-β field. The chief problems to solve are contamination and distortion.

The problems are difficult but not insurmountable. The strength potential in many titanium alloys that can be realized through heat treatment can pay a useful bonus in terms of strength and strength-weight ratio. ■■■

Now! CHANGE SUBMERGED ELECTRODES IN AN HOUR!

. . . without disturbing furnace casing or pot
. . . at substantial savings of labor, material and time



1 Just hoist the removable tile covering . . .

2 Electrodes are now completely accessible for fast changing.

AJAX
HULTGREN
electric SALT BATH furnaces

In this unique new Ajax Electric Salt Bath*, electrodes enter the furnace from over the top, *yet retain all the favorable characteristics of the submerged design.* They are replaced by hoisting a removable tile, putting in new ones and setting the tile back in place.

It's as simple as that! No need to disturb either the pot or furnace casing. "Down time" is held to an absolute minimum. Salt is saved. Spare casings are no longer required. A complete electrode change takes about an hour per pair. Often, the change can be accomplished before the molten salt can solidify.

Write for bulletin giving details of this revolutionary design feature for either new or old Ajax Electric Salt Bath Furnaces.

ALL THE ADVANTAGES OF COMPLETELY SUBMERGED ELECTRODE DESIGN!

The removable tile covering seals the electrodes against air, thus giving all the advantages of submerged design including protection against oxidation at the salt line. Life of new type Ajax electrodes using no critical materials compares more than favorably with that of conventional nickel alloy electrodes in conventional-electrode furnaces.

*Patent Pending

AJAX ELECTRIC COMPANY
940 FRANKFORD AVENUE, PHILADELPHIA 23, PA.

Associate Companies: Ajax Electric Furnace Corporation ● Ajax Engineering Corporation ● Ajax Electrothermic Corporation

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

QUENCHING OIL INFORMATION

A new illustrated 8-page folder which gives valuable information about Gulf Super-Quench has just been released by the Gulf Oil Corporation, Pittsburgh, Pa.

The bulletin describes various case histories involving the use of Super-Quench and shows how some manufacturers have solved a variety of heat treating problems by the use of this quenching oil.

For further information circle No. 12

1956 MTI ACHIEVEMENT AWARD REPRINT

Reprints of the article which won the 1956 MTI Annual Achievement Award are available from the Metal Treating Institute, New Rochelle, N.Y.

The winning article was published in the May-June, 1956 issue of *Metal Treating* and is entitled "Development and Application of the Iso-Hardness Diagram" by A. E. Gurley and C. R. Hannewald of the Chrysler Corporation, Detroit, Mich.

For further information circle No. 13

CONTROL DEVICES FOR JIC STANDARDS

The General Electric Company, Schenectady, N. Y., has just published a 12-page publication which describes application features of General Electric control devices built to meet Joint Industry Conference standards. Illustrated two-color bulletin gives product data on the machine tool relay, oil-tight push button, solenoid, limit switch, magnetic starter, plugging switch, and pneumatic time-delay relay.

For further information circle No. 14

REFRACTORIES BROCHURE

An illustrated history of one of America's few companies which has survived and prospered for a full century—The Robinson Clay Product Company of Akron, Ohio, is now available. Robinson is a regular supplier of refractories.

Since the company's founding in 1856 as a small one-kiln pottery, it has grown to an industrial organization with ten factories, 15 branch offices in key cities throughout the northeastern United States, and more than 15,000 dealers and retailers. The story of its growth parallels and reflects the rise of all American industry during this period, and is interesting not only as a story in itself, but as a capsule history of American industrialization.

For further information circle No. 15

INDUSTRIAL FURNACE BULLETIN

A new 8-page two color gate-fold catalog which shows and describes 27 Standard Rated Surface Heat Treat Furnaces has just been published by Surface Combustion Corp., Toledo, Ohio.

This new bulletin illustrates the large variety of Surface standard equipment for all types of industrial heating applications, from small laboratory furnaces to large continuous brazing furnaces, in a comprehensive and easily digestible form.

For further information circle No. 16

ACETATE JOB TICKET CATALOG

A newly-published catalog of transparent acetate envelopes for industrial use has just been made available by the American Kleer-Vu Plastics, Inc., Maspeth, L.I.

Acetate envelopes are an integral part of the job ticket production system because the clear acetate protects job tickets, blue prints, and charts no matter how much they're manhandled. Instructions stay readable and work flows smoothly without interruption or danger of costly make overs. A free 8½" x 11" size acetate job ticket holder is available.

For further information circle No. 17

POWDER METALLURGY BIBLIOGRAPHY

A bibliography of current periodical references to powder metallurgy has been published for metalworking people interested in this relatively new process. It was prepared by the Harper Electric Furnace Corporation, Buffalo, N. Y., manufacturer of continuous sintering furnaces and heat treating furnaces.

The publication refers to nearly 250 articles and papers printed in more than 50 U. S., English and Canadian technical journals, trade magazines, and business papers during 1954 and 1955, with a few selected earlier references.

For further information circle No. 18

INDICATORS AND RECORDERS DATA SHEET

Concise information about the compact, electronic Speedomax H indicators and recorders now available for precise measurement of rotational or linear speeds, and about the tachometer generators used with them, is presented in an illustrated 2-page Data Sheet just published by Leeds & Northrup Company, Philadelphia, Pa.

This sheet completely lists the features and specifications.

For further information circle No. 19

ELECTRONIC INDUCTION HEATERS

An 8-page bulletin which describes new electronic induction heaters and gives specifications, dimensions, operating information, design features, and ratings is available from the General Electric Company, Schenectady, N. Y.

For further information circle No. 20

VACUUM PROCESSING DATA

The recently increased performance ratings of Stokes rotary mechanical vacuum pumps, as well as a wealth of other useful information that will be helpful to engineers confronted with vacuum processing problems, are contained in a new, completely revised edition of the 28-page catalog on "Stokes Microvac Pumps for High Vacuum" which has just been issued by F. J. Stokes Corporation, Philadelphia, Pa.

Installations of Stokes Microvac pumps, many of which are illustrated in the new catalog, include among many others high vacuum degassing and refinement of steel, copper, and other metals; and annealing and heat treating furnaces.

For further information circle No. 21

HEAT TREATING BERYLLIUM COPPER ALLOYS

A new 8-page catalog describes the methods and procedures used to heat treat Beryllium copper wrought and casting alloys. Divided into two sections, the first covers wrought alloys. It tells how they are supplied and describes both standard and special methods of heat treat hardening. Information is also included on fixtures, furnaces, annealing methods, cleaning and brightening.

The cast alloy section describes the various alloys available in ingot form for customer re-melt. Complete tables of physical and engineering properties of various alloys available are also included along with data on melting, heat treating, special heat treating, furnaces and annealing.

For further information circle No. 22

(Continued on page 40)

HEAT TREATING HIGHLIGHTS

(*Continued from page* 10)

latter is accomplished by imparting an oscillating movement to the circular furnace so as to advance the material being heat treated from the charging port around the ring to the discharge chute and quench tank.

The general field of vacuum heat treating and brazing expanded rapidly, as did vacuum melting. Industry leaders predict that vacuum furnaces currently of the batch type will be available soon as continuous furnaces. Vacuum furnaces are successfully brazing the honey combs now extensively used on high speed military planes.

Dual frequency heating for forging is finding wider application in the commercial field. Billets are heated through the Curie point by low cost 60 cycle equipment and then heated on to forging temperature by high frequency heaters.

Progress in heat transfer—of faster heating and cooling and more uniform heating and cooling is reported by several companies.

In the commercial heat treating field, big news is the development of fully automatic batch type furnaces which include full carbon control equipment. Complete lines, including carburizing, quenching, washing, reheat, final quenching and tempering operations have been set up with complete automation of the entire process.

There has also been developed improved materials handling equipment in both the furnace and induction heating fields. In-line continuous production furnaces have been installed, complete with automatic loading and unloading mechanisms, permitting continuous unattended flow of products through their entire manufacturing cycle.

Installation of a vacuum arc production furnace complete with compacting equipment for compacting titanium and similar metal powders into electrodes at speeds up to 25 pounds per minute produces ingots up to 24" in diameter and 8' in length, weighing 6000 pounds.

A recent improvement in salt bath design permits the quick replacement of submerged electrodes without disturbing the salt bath setting or casing. Costly and time-consuming shutdowns for repairs are avoided.

Endothermic generators and ammonia dissociations utilizing a double pass in the retort equipment, so that the heat contained in the atmosphere on the return pass is used to heat the center of the catalytic bed. This improves uniformity of atmosphere.

The new designs in many products such as produced on the automotive and tractor fields are putting increasing demands on many component parts. These must, in many cases, be stronger with no possibility of increasing size or changing the shape. Several such problems have been solved by the judicious application of induction surface hardening. Notable examples of parts to which this strength increasing process have been applied are axle shafts and steering knuckles.

Salt baths have been successfully applied to the heating of blanks for forging stainless steel turbine blades, also for heating uranium and zirconium for the peacetime atomic energy program.

A good example of complete automation when applied to parts, the heat treatment of which easily falls into production line processing, has been demonstrated in the construction of complete heat treating lines for both roller and ball bearings. These lines not only are fully automated from metered loading of the carburizing furnaces to the final quenching in presses for final sizing, but included in the line are features permitting best utilization of rapid heating, improved quenching and full automatic carbon control.

What's Ahead?

Peering into the future is often a rewarding—although admittedly always a risky business. The Industrial Heating Equipment Association, in its survey, asked the best minds among its membership to predict what the industry will see in days to come.

Undoubtedly, the biggest thing on everybody's mind is automation. It will be used more and more, almost every top executive making industrial heating equipment believes, to cut costs, increase production and improve quality.

Many other factors were noted. These include:

Less use of nickel-chrome alloys on account of further development of ceramics for furnace parts such as hearth plates and skid rails.

Development and more widespread use of safety devices, and instrument control of atmospheres.

More use of 60-cycle, low-temperature induction heating for stress relieving.

More automatic equipment with faster heating rates, high temperatures, and precise controls. The automatic equipment will be controlled from either a tape or cards so that heating cycles can easily be changed by inserting a different card or typing a different instruction on the tape.

Wider application of furnaces generating self-prepared atmospheres for scale-free heating for forming, extrusion and other applications. The use of similar atmospheres for control of scale formation and rolling costly alloys was also mentioned.

Development of atmospheres to obtain entirely new physical or chemical properties in heat treated materials.

Greatly expanded use of vacuum furnaces for heat treating, brazing, and melting.

A rapidly expanding market for industrial heating equipment to supply the growing market for new heat treating processes and new automated production lines, and for quality control instrumentation. ■ ■ ■

In wrought Inconel "Neu-pot", KLK Manufacturing Company, Logansport, Indiana, treats small parts faster. For information about the "Neu-pot" write Rolock, Inc., Fairfield, Connecticut.

Treated in wrought Inconel pots, these small parts cost less

volume goes up, pot replacement down

These parts are done to a turn . . . in nice time, at low cost.

That's because the salt bath is contained in a Rolock "Neu-pot" made of wrought Inconel* nickel-chromium alloy.

KLK Manufacturing Company reported that unlike most "pot" materials, Inconel alloy retains original heat transfer characteristics throughout its useful service life. With it, loads can be hurried along as rapidly as good practice permits. Volume goes up, cost per piece down.

Long pot life lowers cost, too

In this installation, KLK goes on to say, Inconel nickel-chromium alloy also substantially increases pot life. They report that former pots gave, at best, only six weeks service. Their first Inconel "Neu-pot" lasted almost 5 times longer.

In overall pot expense KLK saves 50 percent by using wrought Inconel alloy. The company also realizes a major reduction in down-time. Both savings are reflected in the cost per piece.

Is high sustained heat, or heat plus severe corrosive conditions your problem? If so, look into Inconel. Write for the Inco booklet, "Keep Operating Costs Down As Temperatures Go Up."

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Inconel... *for long life at high temperatures*

MANUFACTURERS' LITERATURE

(*Continued from page 37*)

AIR-DRIVEN MOLTEN SALT PUMP

A bulletin published by the Ajax Electric Company, Philadelphia, Pa., describes an air-driven molten salt pump designed especially for pumping molten salts and metals. The advantages of an air-driven motor for operation under high ambient temperatures are discussed, and typical uses for the pump, such as emptying large aluminum heat-treating furnaces, are listed. Photo, sketch, and performance data are included.

For further information circle No. 23

REFRACTORY CATALOG

The Plibrico Company, Chicago, Illinois, is offering a 32-page catalog of its refractory products for industrial, foundry and steel mill furnaces.

The two-color, well-illustrated booklet describes the products and shows various installations along with schematic diagrams and charts for product applications. Stress relieving, heat treating, annealing, normalizing and other processes are discussed.

For further information circle No. 24

M.T.I. *Activities*

1956 ANNUAL MEETING

The Annual Meeting of the Metal Treating Institute was held at the Hotel Cleveland, Cleveland, Ohio, on October 5, 6, and 7, 1956. This was the 40th consecutive meeting of the Institute.

One of the highlights of the meeting was on Saturday, October 6, when the President of the Institute, Mr. Howard N. Bosworth of Bosworth Steel Treating Company, Detroit, Michigan, made the presentation of the Annual MTI Achievement Award, (See cut.)

Mr. A. E. Gurley of the Chrysler Corporation, Detroit, Mich. (right) is presented with the Annual MTI Achievement Award Plaque by President Howard N. Bosworth. Mr. C. R. Hannewald was the other co-winner of the award but was unable to be present, and Mr. Gurley also accepted Mr. Hannewald's plaque.

This award is made annually to the author of the most outstanding lecture presented at the previous Annual or Spring Meetings or for any feature article appearing in the magazine METAL TREATING during the preceding year's issues.

The winners this year were A. E. Gurley and C. R. Hannewald of the Chrysler Corporation, Detroit, Michigan, for the joint authorship of their article entitled "Development and Application of the Iso-Hardness Diagram" which appeared in the May-June 1956 issue of METAL TREATING.

Some outstanding speeches were also delivered during the technical sessions of the three-day meeting. On Friday, October 5, after President Bosworth's welcoming address, Mr. C. M. Cook, of Cook Heat Treating Co. of Texas, presented the report of the Labor Relations Committee, of which he is Chairman, followed by the showing of the motion picture "Loaded Package," which deals with the subject of supplemental unemployment benefits. Later in the afternoon Mr. C. M. Cook was also presented with the Past President's Plaque. (See cut). Mr. Cook was President of the Metal Treating Institute for two terms during the years of 1954 and 1955.

President Bosworth is presenting the Past President's Plaque to Mr. Clifford M. Cook of Cook Heat Treating Co. of Texas. Mr. Cook was president of the Institute for two terms during the years 1954 and 1955.

Friday afternoon's session was devoted to two illustrated lectures. One was by Mr. H. L. Hovis, Superintendent of Metals Processing, Hamilton Watch Company, Lancaster, Pennsylvania. He talked on "Vacuum Annealing and Bright Hardening" and showed the film entitled "Heat Treating and Metals Processing at Hamilton Watch Company." The other was by Mr. Joseph S. Pendleton, Jr., Metallurgist, Carpenter Steel Company, Reading, Pennsylvania, who talked and showed a film on the subject of "Four Steps to Better Tools and Dies."

The session on Saturday, October 6, featured a talk by Mr. A. O. Schaefer, President of the American Society for Metals and Director of Research, Midvale-Heppenstall Company, Nicetown, Pennsylvania. He spoke on the subject of "America Needs Metallurgists." The rest of the morning session was a symposium on METAL TREATING magazine, with Horace C. Knerr, Chairman of the Publication Committee, presiding. Three talks were presented. "The Birth and Growth of METAL TREATING magazine," by C. E. Herington, Editor of the magazine and Executive Secretary of the Metal Treating Institute; "Producing a Magazine from Manuscript to Readers' Desk," by H. R. Herington, Assistant Editor and Business Manager of METAL TREATING; and "Selling METAL TREATING to Advertisers," by A. W. Collier, Midwest Sales Representative of METAL TREATING.

Saturday evening featured the Annual Reception and Banquet with entertainment provided by a floor show and dancing.

The following officers were unanimously re-elected at the business meeting on Sunday, October 7th: President, H. N. Bosworth, Bosworth Steel Treating Company, Detroit 28, Michigan; Vice-President, K. U. Jenks, Lindberg Steel Treating Co., Inc., Melrose Park, Illinois; Treasurer, L. G. Field, Greenman Steel Treating Co., Worcester 5, Massachusetts.

The following members of the Board of Trustees are serving the second year of their two-year terms: C. G. Anderson, Anderson Steel Treating Co., Detroit 7, Michigan; Robert Davis, Perfection Tool & Metal Heat Treating Co., Chicago 22, Illinois; A. T. Ridinger, Metallurgical, Inc., Minneapolis 14, Minnesota; C. H. Knerr, Metlab Company, Philadelphia 18, Pennsylvania; C. M. Cook, Cook Heat Treating Co. of Texas, Houston 11, Texas.

Two new members of the Board of Trustees were also elected: John P. Benedict, Benedict-Miller, Inc., Lyndhurst, New Jersey; John H. Ries, The Lakeside Steel Improvement Co., Cleveland 14, Ohio.

MEMBER HOLDS OPEN HOUSE

The Metlab Co., of Philadelphia, Pa. has for the past several years given an Open House party for its

The "Aqua-Delphians," intercollegiate swimming and diving champions, who gave an exhibition in the Metlab pool.

MTI Members See New Lindberg Furnace

MTI members listen carefully as Cary Stevenson of Lindberg Engineering Co. explains details of new Induct-O-Ring heat treating furnace. (Left to right) Cary Stevenson, Horace C. Knerr, Charles G. Heilman, Michael Kober, Fred Heinzelman, Jr., C. W. Derhammer, Fred Heinzelman, Sr., Joseph H. Bockrath, Howard N. Bosworth, Arthur Eklund, Jr., Ben F. Rassieur, and K. W. Ward.

(*Continued from page 43*)

customers, suppliers and special groups. The latest of these parties was held recently at which nearly one hundred persons attended.

As they arrived about 3 p.m., the guests were assembled into groups of about 10 persons, each with a guide to explain the various departments and operations in the plant. Following this tour of the plant, the guests entered the recreation field and engaged in various sports or took a swim in the private pool.

One of the groups at the Metlab Co. Open House Party listening to Sales Manager George Richardson (upper right) explain the quenching process in the company's Inverted Pit furnace.

During this recreation period there was an exhibition of swimming and diving by Mickey Becket's "Aqua-Delphians", intercollegiate diving champions, and by two Metlab "Mermaids".

These activities were followed by a visit to the cocktail bar at 5:30 p.m., after which the guests partook of a grill supper on the lawn, entirely prepared and served by members of the company.

After supper several motion pictures were shown—all supplied by the courtesy of the U. S. Army and Navy.

Member Gets Patent

Mr. Philip C. Osterman, Vice President of American Metal Treatment Co., Elizabeth, N. J,. and President of American Gas Furnace Co. of Elizabeth, N. J., has recently been granted U. S. Patent No. 2,726,854 upon new and improved heat treating equipment. The new invention makes possible advance of automation and the utilization of automatic heat treating in a continuous production line. For more detailed information see the item in this issue in "News to Heat Treaters."

7 Furnaces at SPERRY RAND

In the Sperry Electronic Tube Division of SPERRY RAND, Gainesville, Florida, a battery of 7 Sargeant & Wilbur furnaces perform faithfully and economically, aiding in the production of klystron tubes.

● Five S&W Conveyor Furnaces with 15" belts are used for silver and copper brazing of klystron tube components, as well as for degassifying and oxidizing.

Two S&W Pusher Furnaces are used primarily for brazing operations.

Atmosphere is dissociated ammonia, produced from two 2,000 CFH S&W Ammonia Dissociators.

Purging atmosphere is supplied by a 1500 CFH Forming Gas Generator. This atmosphere is dried by an automatic, activated alumina dryer.

Write today for literature—and state your problem. Our staff of engineers is ready to advise without obligation.

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RIGHT OR WRONG IN LABOR RELATIONS

(Continued from page 28)

What Arbitrator Marion Beatty Ruled:

"If I were satisfied that Edon was an unwilling participant trying to disengage himself, and returned just enough blows to protect himself I would probably hold for him. I am inclined to agree with his position that it should not be necessary for him to 'take a dive' or 'run like a rabbit' in order to keep his job.

"There were other witnesses to the incident, and by their testimony I am convinced that both men were angry and both were willing participants in a fist fight on company premises for a minimum of 15 minutes. It was a real fight, not just horseplay or any pushing, powder-puff affair.

"I am satisfied that either party could have suspended hostilities in much shorter order or 'stepped outside' and off the premises in much less than the 15 minutes, and with fewer blows if either one had not been so angry.

"Every mature person must know that engaging in a violent fist fight on company property is detrimental to the business, can be injurious to property and persons, and that it cannot be condoned. I find that the company had sufficient and just cause for the discharge of Edon." ■■■

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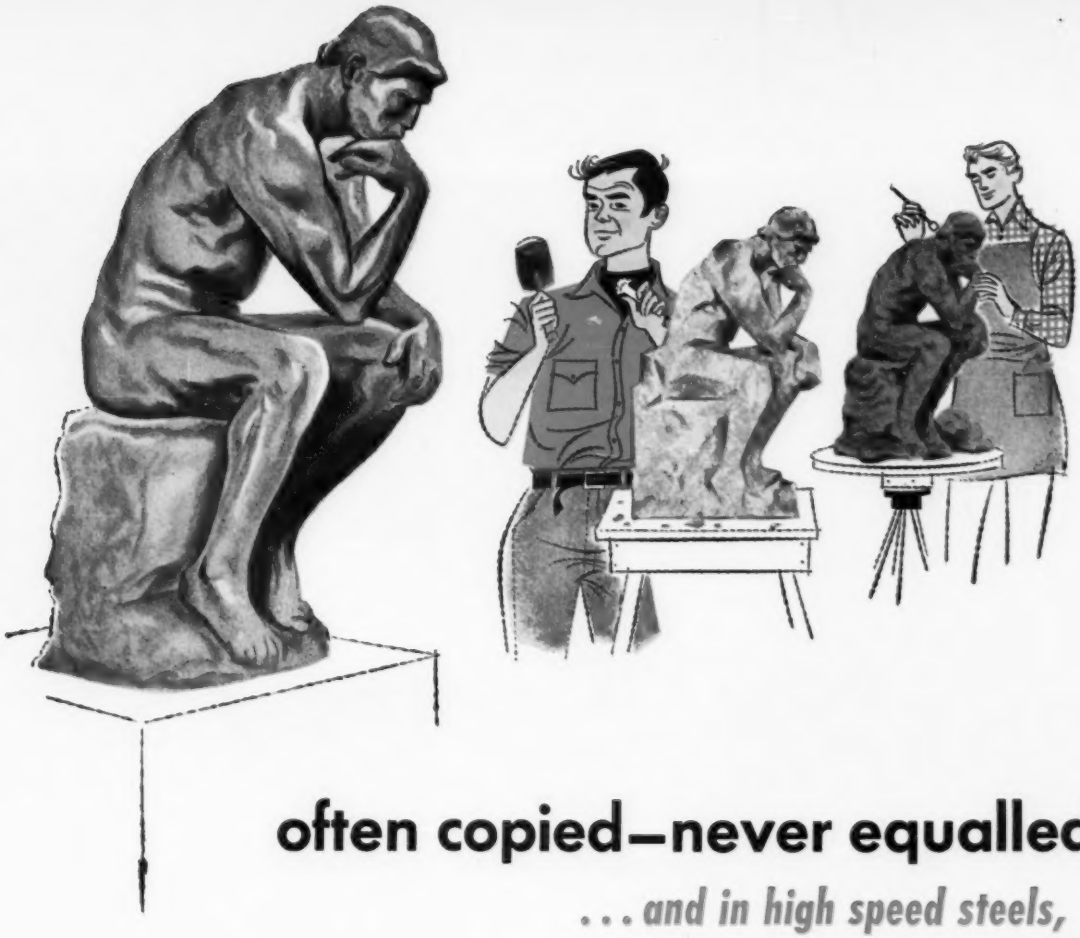

often copied—never equalled

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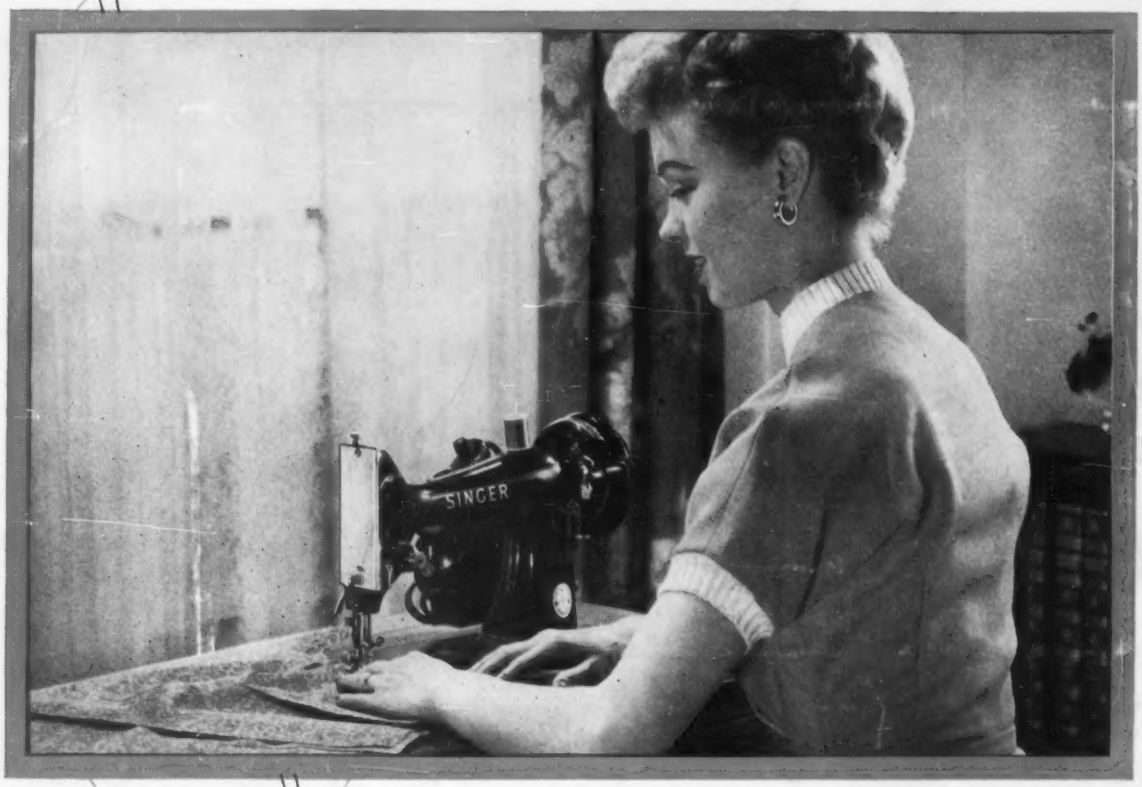

The Singer Manufacturing Company, Elizabethport, N. J., finds that AEROCARB E and W Carburizing Baths make it easy to control case depths of their sewing machine parts within thousandths of an inch, producing excellent wear resistance.

Vertical operating presser bar shafts and needle bar shafts for their 99 Class Sewing Machines are case-hardened at 1650°F. SINGER gets fast penetration with minimum distortion, and finds water-soluble AEROCARB E & W easy to remove. Parts emerge from the carburizing operation bright, clean and straight, ready for fast and easy finishing.

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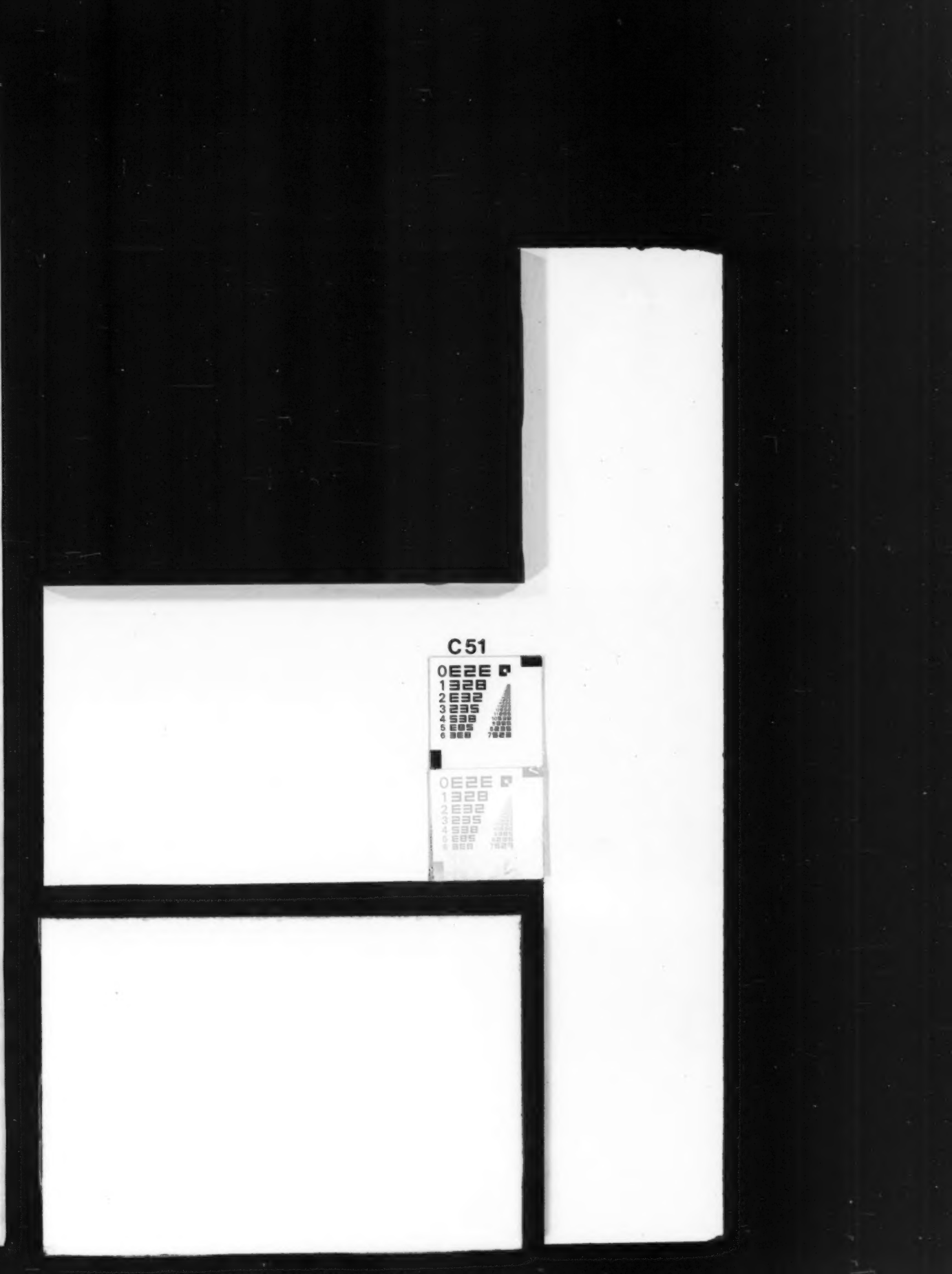
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